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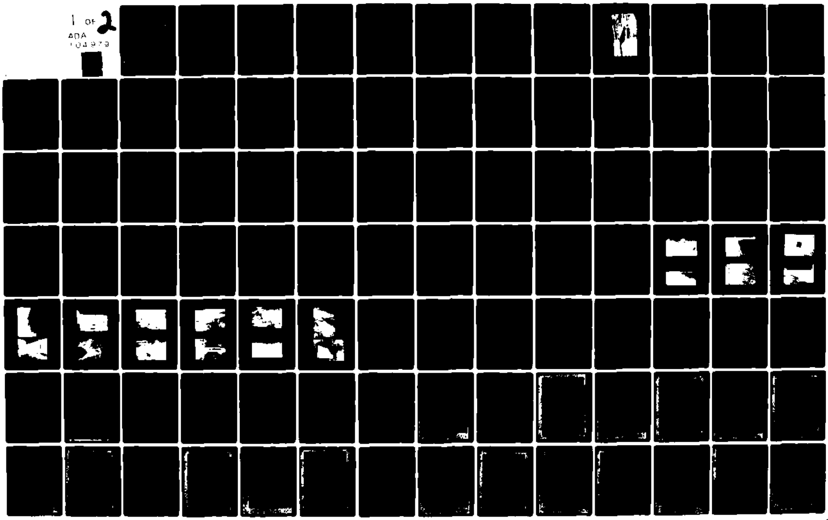

LEVEL II

MISSISSIPPI·SALT·QUINCY RIVER BASIN

AD A104979

LANCASTER CITY DAM
SCHUYLER COUNTY, MISSOURI
MO. 10851

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

DECEMBER 1979

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Lancaster City Dam (Mo. 10851) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lancaster City Dam (Mo. 10851).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY:	SIGNED Chief, Engineering Division	26 DEC 1979 Date
APPROVED BY:	SIGNED Colonel, CE, District Engineer	26 DEC 1979 Date

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LANCASTER CITY DAM
SCHUYLER COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10851

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
CONSOER, TOWNSEND AND ASSOCIATES, LTD.
ST. LOUIS, MISSOURI
AND
ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

DECEMBER 1979

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lancaster City Dam, Missouri Inv. No. 10851
State Located:	Missouri
County Located:	Schuyler
Stream:	An unnamed tributary of the North Fork of the Middle Fabius River
Date of Inspection:	August 21, 1979

Assessment of General Condition

Lancaster City Dam was inspected by the engineering firms of Consoer, Townsend and Associates, Ltd., and Engineering Consultants, Inc. (A Joint Venture) of St. Louis, Missouri according to the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. Within the estimated damage zone of two miles downstream of the dam are two dwellings and the intersection of U.S. Highway 63 and 136, which may be subjected to flooding, with

possible loss of life. Lancaster City Dam is in the small size classification since it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

Our inspection and evaluation indicates that the spillway of Lancaster City Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Lancaster City Dam being a small size dam, with a high hazard potential, is required by the guidelines to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping. Considering the volume of water impounded, the relatively narrow valley, two dwellings and the intersection of two highways downstream of the dam, the PMF is considered the appropriate spillway design flood. It was determined that the reservoir/spillway system can accommodate 35 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation indicates that the reservoir/spillway system will accommodate the 100-year flood without overtopping.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The 100-year flood is defined as a flood having a one percent chance of being equalled or exceeded during any given year.

Other deficiencies noted by the inspection team were: the deteriorating conditions of the spillway and the discharge channel; rodent activity on the embankment; wave erosion on the upstream slope of the embankment; the cracks observed on the downstream embankment slope; a need for periodic inspection by a qualified engineer and a lack of maintenance schedule. The lack of stability and seepage analyses on record is also a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above.

Walter G. Shifrin, P.E.

Overview of Lancaster City Dam

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

LANCASTER CITY DAM, I.D. No. 10851

TABLE OF CONTENTS

TABLE OF CONTENTS

(Continued)

TABLE OF CONTENTS

(Continued)

LIST OF PLATES

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LANCASTER CITY DAM, Missouri Inv. No. 10851

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Lancaster City Dam was carried out under Contract DACW 43-79-C-0075 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of Consoer, Townsend & Associates, Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of Lancaster City Dam was made on August 21, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an assessment of hydrologic and hydraulic conditions at the site; presents an assessment as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing, and detailed analyses were not within the scope of this study. The conclusions drawn herein, therefore, are based on the presence of, or absence of, obvious signs of distress. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that reference in this report to left or right abutments is as viewed looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to the east abutment or side, and right to the west abutment or side.

d. Evaluation Criteria

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in the publication "Recommended Guidelines for Safety Inspection of Dams", Appendix D. These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 Description of the Project

a. Description of Dam and Appurtenances

It should be noted that design or as-built drawings are not available for the dam or appurtenant structures. The following description is based exclusively on observations and measurements made during the visual inspection.

The dam is an earthfill structure between earth abutments. The crest is 10 feet wide and 440 feet long (excluding the width of the spillway). The crest elevation is approximately 909.0 feet above M.S.L. and the maximum height of the embankment is about 13 feet.

The downstream slope was measured as 1V to 2.5H. The upstream slope was measured as 1V to 2.75H from water surface to crest.

The spillway for Lancaster City Dam is located 68 feet to the left of the right abutment. The spillway is an uncontrolled, trapezoidal concrete weir. The control section of the spillway has a bottom width of 53.5 feet and a top width of 58.5 feet and is 5.5 feet high. The crest width of the control section is 2.5 feet. Discharge through the weir drops 6 feet vertically into a 46.5 foot wide by 120 foot long concrete lined discharge channel. The channel has concrete retaining walls for the first 50 feet. The retaining walls have slopes of 2.5V to 1.0H. The remaining portion of the channel has a rock masonry wall on the left side and a concrete block masonry wall on the right side.

There are two low level outlets for the Lancaster City Dam. One outlet is a water supply system. The system consists of a 6-inch pipe which passes from an intake structure in the reservoir to a rectangular, concrete manhole located approximately 75 feet downstream of the toe of the dam and approximately 200 feet to the right of the left abutment. In the concrete manhole, flow through the 6-inch pipe can be diverted into either a 4-inch pipe which goes to a pumphouse located on the left abutment or a 6-inch drain pipe. Both the 6-inch main line and the 6-inch drain pipe are controlled by gate valves. The intake structure, located in the reservoir, consists of an uncontrolled 30-inch diameter concrete standpipe. The pumphouse located on the left abutment houses one centrifugal pump.

The other low level outlet is a drain pipe of unknown diameter, according to a former water superintendent for the City of Lancaster. The drain is controlled by a valve located approximately 75 feet downstream of the toe of the dam and approximately 100 feet to the left of the left side of the spillway. The valve is housed in a square concrete box.

b. Location

The Lancaster City Dam is located near the headwaters of the North Fork of the Middle Fabius River. The city of Lancaster, population 851, is located less than one mile downstream of the dam. The dam is located in Section 14, Township 66 North, Range 15 West as shown on an unpublished map of the Moulton Southeast Missouri and Iowa Quadrangle topographic map (7.5 minute series).

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams", by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam size category as being "Small" since its storage is less than 1,000 acre-feet. The dam is also classified as "Small" in dam size category because its height is less than 40 feet. The overall size classification is, accordingly, "Small" in size.

d. Hazard Classification

The dam has been classified as having "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with the classification. The estimated damage zone extends approximately two miles downstream of the dam. Within the estimated damage zone are two dwellings and the intersection of U.S. Highways 63 and 136.

e. Ownership

The Lancaster City Dam is owned by the City of Lancaster. The mailing address is City of Lancaster, c/o Max Wheeler, Water Superintendent, Lancaster, Missouri, 63548.

f. Purpose of Dam

The main purpose of the dam is to impound water for recreational use and a supplemental water supply.

g. Design and Construction History

The Lancaster City Dam was designed in 1938 by Mr. Fred E. Dawkins and Mr. Leir of the WPA. According to Mrs. I. Small, City Clerk, Lancaster, the construction was supervised by Mr. Spencer Mitchell also of the WPA. Efforts to contact the original designer and contractor were futile. Construction was completed on or near November 15, 1939. According to the City Water Superintendent, Mr. Max Wheeler, the spillway crest elevation was increased by 30" in 1953 (est.). This is the only major post construction change known.

h. Normal Operational Procedures

Typical procedure for Lancaster City Dam is to allow the water level below the spillway crest to remain as high as possible, as it is controlled by rainfall, runoff, and evaporation. According to the water superintendent, Max Wheeler, the city is presently utilizing only a small amount of water from this reservoir.

1.3 Pertinent Data

a. Drainage Area (square miles): 1.01

b. Discharge at Damsite

Estimated experienced maximum flood (cfs):	NA
Estimated ungated spillway capacity with reservoir at top of dam El. (cfs):	1653

c. Elevation (feet above MSL)

Top of dam:	908.6
Spillway crest:	904 (assumed)
Normal Pool:	904
Maximum Pool (PMF):	911.13

d. Reservoir

Length of pool with water level at top of dam elevation (feet):	3000

e. Storage (Acre-Feet)

Top of dam:	325
Spillway crest:	151
Normal Pool:	151
Maximum Pool (PMF):	482

f. Reservoir Surface (Acres)

Top of dam:	46
Spillway crest:	32.3
Normal Pool:	32.3
Maximum Pool (PMF):	50$\pm$

g. Dam

Type:	Earthfill
Length:	440 feet (excluding the width of the spillway)

Structural Height:	13 feet
Hydraulic Height:	13 feet
Top width:	10 feet
Side slopes:	
Downstream	1V to 2.5H
Upstream	1V to 2.75H (From the crest to the water surface)
Zoning:	Unknown
Impervious core:	NA
Cutoff:	Cutoff trench to bedrock (approximately 17 feet)
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel None

i. Spillway

Type:	Trapezoidal weir, uncontrolled
Length of crest:	53.5 feet
Crest Elevation (feet above MSL):	904.0 (assumed)

j. Regulating Outlets

1. Outlet No. 1

Type:	6-inch water supply system
Length:	Unknown
Closure:	Gate valve
Maximum Capacity:	Unknown

2. Outlet No. 2

Type:	Low level drain pipe (unknown diameter)
Length:	Unknown
Closure:	Valve
Maximum Capacity:	Unknown

SECTION 2 : ENGINEERING DATA

2.1 Design

Design drawings or calculations are not available for Lancaster City Dam. It is doubtful if any plans exist for this dam.

2.2 Construction

No construction records or data are available for the dam and appurtenant structures, other than the construction history given in Section 1.2g.

2.3 Operation

No operational data are available for Lancaster City Dam.

2.4 Evaluation

a. Availability

No design drawings, design computations, construction data, or operational data are available.

In addition, no pertinent data were available for review of hydrology, spillway capacity, flood routing through the reservoir, outlet capacity, slope stability, seepage analysis, or foundation conditions.

b. Adequacy

The lack of engineering data did not allow for a definitive review and evaluation. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing and evaluating design, operation and construction data, but was based primarily on visual inspection, past performance history, and sound engineering judgment.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions and made a matter of record.

c. Validity

No valid engineering data were available.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Lancaster City Dam was made on August 21, 1979. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Dr. M.A. Samad	Engineering Consultants, Inc.	Project Engineer, Hydraulics and Hydrology
Mark R. Haynes	Engineering Consultants, Inc.	Civil, Structural and Mechanical
Dawn L. Jacoby	Engineering Consultants, Inc.	Soils
Peter L. Strauss	Engineering Consultants, Inc.	Geology
Kevin Blume	Consoer, Townsend & Assoc., Ltd.	Civil and Structural
Max Wheeler	Water Superintendent, City of Lancaster	

During the inspection of the dam, a telephone conversation was held with Mr. Glen Ayer, the former Water Superintendent of the City of Lancaster.

Specific observations are discussed below.

b. Dam

The crest of the dam is protected against surface erosion by a cover of grass and clover. There was no evidence of significant settlement or cracking on the crest. No deviations in horizontal or vertical alignment were apparent. Some evidence of rodent activity was observed on the embankment. There was no evidence of the dam ever being overtopped.

The upstream slope was protected by concrete rubble riprap to one foot above the water surface. Considerable erosion due to wave action above the riprap indicates the riprap might have been placed after construction of the dam. Scarps ranging from 1 to 3 feet high have been cut into the upper part of the upstream face. Several bushes and small trees were growing on the upper grass covered slope. No bulges or depressions in the slope were observed.

The downstream slope was protected by an adequate grass cover and tall weeds. Non-continuous transverse cracks measuring up to one inch wide were observed on the slope. These cracks did not appear to be related to slope movement. No depressions or bulges were apparent. No seepage was apparent on the slope or downstream of the toe. Materials removed immediately below the topsoil on the embankment appeared to be a silty clay.

According to the "Missouri General Soil Map and Soil Association Description", soils in the general area of the dam belong to the soil series of Mexico-Leonard-Armstrong-Lindley in the Central Claypan Area forest. The soils are basically formed from loess and glacial till, and would be subject to excessive erosion, a concern if overtopping occurs during a flood. The permeability of these soils range from slow to moderately slow.

The left abutment is approximately the same elevation as the dam crest. An access road covers the crest contact area. The right abutment slopes upward from the crest. Neither abutment shows signs of erosion or instability. A combination pumphouse and water treatment plant is located on the left abutment.

c. Project Geology

The damsite is physiographically located in the Dissected Till Plains Section of the Central Lowlands Physiographic Province, according to Nevin Fenneman's "Physiography of the Eastern United States". This section is distinguished from the Till Plains on the east and from the Young Drift section on the north by the stage it has reached in the post-glacial erosion cycle. Broadly generalized, this section is a nearly flat till plain submature to mature in its erosion cycle.

No folds or faults have been identified in the vicinity of the dam.

The site bedrock geology, beneath the drift, as shown on the Geologic Map of Missouri, (1979), is interbedded Pennsylvanian age shales, limestones, and sandstones. These strata generally strike north-south and dip gently to the west.

No bedrock was seen at or in the vicinity of the damsite. The entire area is mantled by glacial drift.

d. Appurtenant Structures

(1) Spillway

The top 30 inches of the concrete weir, which was added in 1953, has separated at each end of the weir from the wingwalls constructed at the same time. The crest of the weir has tilted five degrees downstream. An approximately 3-inch wide gap between both wingwalls and the weir was observed. Sheared reinforcing bars were observed in the gap. It appeared that the only reasons for the top 30 inches of the weir being held in place was the friction between the weir and the original retaining wall and the dead weight of the weir itself. Seepage was observed flowing through the contact between the weir and the retaining wall on both ends of the weir. The combined flow rate of the two seepages was estimated to be 20 to 30 gpm. A few small pressurized seeps were observed along the weir exiting from the joint between the original concrete and the new concrete of the weir. No trashrack was provided for the spillway.

The concrete slab of the spillway discharge channel showed signs of differential settlement. Offsets in the concrete were observed along most of the construction joints. Three holes in the slab were observed near the sides of the

channel from 10 to 60 feet downstream of the weir. Two of the holes are on the right side of the channel and one hole is on the left side. The discharge of the seepage described above was exiting the discharge channel through the holes in the slab. Evidence of undermining of the slab was detected which appeared to be due to discharges through the holes in the slab. Hollow sounds could be heard by tapping on the concrete slab. The downstream end of the channel has also been undermined. Due to the undermining, portions of the slab have broken off and are resting several feet downstream. Seepage was observed at the downstream end of the channel which was assumed to be the discharge described above. Vegetation was growing between the construction joints in the slab and debris was observed in the channel. Some minor temperature cracks, minor spalling of the concrete and exposed reinforcement were observed in the discharge channel.

The concrete retaining walls of the discharge channel appeared to be in stable condition. Weep holes were provided for the walls at different elevations. Some temperature cracks were observed on the walls. The top few inches of the concrete footing of the retaining wall on the left side of the channel has spalled off. Reinforcement has been exposed in this area and the reinforcement shows signs of differential settlement between the discharge channel slab and the footing of the retaining wall.

The concrete block masonry wall on the right side appeared to be in stable condition except for the downstream end of the wall. A one-half inch wide vertical crack extending the full height of the wall was observed in mortar between the blocks. The crack appeared to be due to an instability in the wall caused by a large cavity behind the wall. The cavity behind the wall appeared to be due to the undermining of the

slab of the channel. Downstream of the concrete block wall, a rock masonry wall appeared to have been constructed. Most of the rock masonry wall had collapsed due to undermining.

The rock masonry wall on the left side of the channel appeared to be in stable condition. No cracks were observed. No evidence of structural instability was observed.

(2) Outlet Works

The water supply system appeared to function properly. The control valves for the system were located downstream of the dam and were inaccessible on the day of the inspection due to water from a recent rainstorm in the manhole. The intake structure located in the reservoir appeared to be in stable condition.

The inlet and outlet of the low level drain were not located. The control valve for the drain was inaccessible on the day of the inspection due to water from a recent rainstorm in the valve housing. According to the former water superintendent, the valve is operable.

e. Reservoir Area

The water surface elevation was 903.4 feet above MSL on the day of the inspection.

The resrevoir rim was gently sloped and no indication of instability or severe erosion was readily apparent. The slopes above the reservoir were heavily grassed. No buildings or dwellings were built around the reservoir rim. A pumphouse was built on the left abutment.

f. Downstream Channel

The downstream channel of the spillway was obstructed just downstream of the discharge channel by trees and concrete rubble. The channel beyond the obstructions is a well defined channel through a wooded area. The bottom width of the channel is about 15 feet and the depth is about 3 feet.

3.2 Evaluation

The visual inspection did not reveal any items which are sufficiently significant to indicate a need for immediate remedial action.

The following conditions were observed which could affect the safety of the dam or which will require maintenance within a reasonable period of time.

1. Erosion of the upstream slope due to wave action.

2. The cracks on the downstream slope.

3. The evidence of burrowing animals' activities observed on the embankment.

4. The following conditions of the spillway and the discharge channel:

    a. The instability of spillway weir.

b. Seepage through the joint between the original and new construction of the weir.

c. Undermining of the slab of the channel.

d. Undermining of downstream end of the channel.

e. Cavity behind wall on the right side of the channel.

f. Vegetation and debris in channel.

5. The obstructions in the downstream channel just downstream of the end of the discharge channel.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Lancaster City Dam was built primarily for water supply purposes. The city at this time is pumping only a token amount of water from the reservoir. The reservoir is also used by local residents for recreational purposes.

There are no specific operational procedures for the dam. The spillway is an open channel with a broad crested weir which requires no attention for its operation.

4.2 Maintenance of Dam

The dam is maintained by the city water superintendent, Max Wheeler. Repairs are made as they are needed. The downstream slope and the crest are mowed periodically and kept fairly clear of trees.

4.3 Maintenance of Operating Facilities

The operating facilities at the damsite are the control valves for the 6-inch combination water supply and outlet pipe, and the control valve for another outlet pipe of unknown size. Controls for both the systems were inaccessible during the inspection.

These structures are maintained by the water superintendent, Mr. Wheeler.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any existing warning system in effect for this dam.

4.5 Evaluation

The operation and maintenance for this dam with related structures seemed to be fairly adequate with the exception of the condition of the low level outlet and the items mentioned in Section 7 as needing remedial action.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

Lancaster City Dam has a watershed of approximately 646 acres below Ursel Gingerich Dam (Mo. 10393). The total watershed area, including Ursel Gingerich Dam's watershed is approximately 774 acres. Lancaster City Dam Reservoir is located on an unnamed tributary of the North Fork of Middle Fabius River. A drainage map showing the watershed area and the location of the two dams is given as Plate 1 in Appendix B. The reservoir of Ursel Gingerich Dam drains into the Lancaster City Dam reservoir. The watershed area is wooded and covered with grass. At its longest arm the watershed for Lancaster City Dam is 1.44 miles long. Land gradients in the higher regions of the watershed average about 4 percent and in the lower areas surrounding the reservoir average about 13 percent.

Evaluation of the hydraulic and hydrologic features of Lancaster City Dam was based on criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometeorological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based on criteria given in the

Corps of Engineers' EM 1110-2-1411 (Standard Project Storm). The Soil Conservation Service (SCS) method was used for deriving the unit hydrographs, utilizing the Corps of Engineers' computer program HEC-1, (Dam Safety Version). Two unit hydrographs, one for each of the two dams were derived. The parameters of the unit hydrographs are presented in Appendix B. The SCS method was used for determining the loss rate. The hydrologic soil group of the watershed was determined by use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are also presented in Appendix B. The curve number, unit hydrograph parameters, and the PMP rainfall were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrographs. The computed peak discharges of the PMF for Ursel Gingerich Dam and for drainage area below Ursel Gingerich Dam and above the Lancaster City Dam are 2,113 and 7,243 cfs, respectively. The peak discharges for one-half of the PMFs are 1,057 and 3,622 respectively.

Both PMF and one-half of the PMF inflow hydrographs at the upstream dam (Ursel Gingerich Dam) were routed through the upstream reservoir by the Modified Puls Method, also utilizing the HEC-1 (Dam Safety Version) computer program. The peak outflow discharges for the PMF and one-half of the PMF at Ursel Gingerich Dam are 1,680 and 475 cfs, respectively. The routed hydrograph at Ursel Gingerich Dam was combined with the inflow hydrograph at Lancaster City Dam. The combined hydrograph was then routed through the Lancaster City Dam Reservoir. The peak outflow discharges for the PMF and one-half of the PMF at the Lancaster City Dam are 7,322 and 2,742 cfs, respectively. Both the PMF and one-half of the PMF, when routed through Lancaster City Dam Reservoir, resulted in overtopping of the dam. It has been assumed that both the dams remain intact during the routing.

The size of physical features utilized to develop the stage-outflow relation for the spillways and overtop of the dam were determined from field notes and sketches, prepared during the field inspection. The reservoir stage-capacity data were based on an unpublished topographic map of Moulton SE, Missouri and Iowa (7.5 minute series). The spillway and dam overtop rating curve and the reservoir capacity curve for Lancaster City Dam are presented in Plates 2 & 3 respectively in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam must aim at avoiding overtopping. Overtopping is especially dangerous for an earth dam because of its erosive characteristics. The safe hydrologic design of a dam requires a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineers design dams to safely pass the Probable Maximum Flood that could be generated from the dam's watershed. This is the generally accepted criterion for major dams throughout the world, and is the standard for dam safety where overtopping would pose any threat to human life. Accordingly, the hydrologic requirement for safety for this dam is the capability to pass the Probable Maximum Flood without overtopping.

b. Experience Data

It is believed that no records of reservoir stage or spillway discharge are maintained for this site.

c. Visual Observations

Observations made of the spillway during the visual inspections are discussed in Section 3.1c(1) and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1.a, both the Probable Maximum Flood and one-half of the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharges for the PMF and one-half of the PMF at Lancaster City Dam are 7,322 and 2,742 cfs respectively. The PMF overtopped the dam crest by 2.63 feet, and one-half of the PMF overtopped the dam crest by 0.96 feet. The total duration of embankment overflow is 4.67 hours during the PMF, and 1.75 hours during one-half of the PMF. The spillway/reservoir system of Lancaster City Dam is capable of accommodating a flood equal to approximately 35 percent of the PMF before overtopping the dam. Therefore, the spillway/reservoir system of Lancaster City Dam will accommodate the 100-year flood without overtopping.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends approximately two miles downstream of the dam. Within the damage zone are two dwellings and the intersection of Highways 63 and 136.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no major signs of settlement or distress observed on the embankment or foundation during the visual inspection. The upstream slope of the embankment is exhibiting sloughing and erosion due to wave action. The condition does not appear to be serious at this time, but the condition should be watched and the slope stabilized as required. The cracks on the downstream slope are not necessarily indicative of slope failure, but they should be monitored. In the absence of seepage and stability analyses, however, no quantitative evaluation of the structural stability can be made.

The overall condition of the spillway and discharge channel appears to be structurally unstable. The condition of the spillway and discharge channel is described in detail in Section 3.1b(1).

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. No embankment or foundation soil parameters were available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of

embankment compaction were available for use in a stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam or appurtenant structures. The water level on the day of the inspection was 7 inches below the crest of the spillway, and it is assumed that the reservoir remains close to full at all times. The water supply system is operational and the low level drain is reportedly operable.

d. Post Construction Changes

The top 30 inches of the spillway weir, which was added in 1953, could affect the structural integrity of the dam. By raising the spillway elevation, the capacity of the reservoir to accommodate a certain size flood has been decreased, therefore, the potential of the dam being overtopped has been increased. Also, with the reservoir level raised above the original design pool elevation, the additional water pressure could jeopardize the structural stability of the embankment.

No other post construction changes exist which will affect the structural stability of the dam.

e. Seismic Stability

The dam is located in Seismic Zone 1, as defined in "Recommended Guidelines For Safety Inspection of Dams" as prepared by the Corps of Engineers. A well designed and constructed earthen dam should not suffer damage as a result of an earthquake of Zone 1 intensity.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation, however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be assurance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Lancaster City Dam was found to be "Seriously Inadequate". The spillway/reservoir system will accommodate only 35 percent of the PMF without overtopping the dam. The surface soils on the dam are quite silty. The dam is overtopped by over 2-1/2 feet during the PMF and the duration of embankment overflow is over 4-1/2 hours. If the material in the dam is silty soil, the dam will be susceptible to erosion and failure during overtopping.

No quantitative evaluation of the safety of the embankment can be made in view of the absence of seepage and stability analyses. The present embankment, however, has reportedly performed satisfactorily since its construction without failure or evidence of instability.

Neither the erosion due to wave action on the upstream slope nor the cracks on the downstream slope affect the safety of the dam in their present conditions. Nevertheless, the conditions should be monitored and corrective measures undertaken as required.

The safety of the spillway and discharge channel appears to be in jeopardy due to their deteriorated condition. Therefore, it is recommended that a rehabilitation project be undertaken to repair the spillway and the discharge channel.

The debris and trees just downstream of the end of the discharge channel affect the normal operation of the channel. The debris and trees should be removed and the channel kept free of obstructions.

The burrowing animals observed on the embankment could jeopardize the safety of the dam. The holes created by the animals make avenues for possible piping. The extent of damage to the embankment done by the burrowing animals should be determined and corrective measures undertaken as required.

b. Adequacy of Information

Pertinent information relating to the design and construction of the dam is completely lacking. The conclusions presented in this report are based on field measurement, past performance and present condition of the dam. Information on the design hydrology, hydraulic design, and the

operation and maintenance of the dam were not available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency

The remedial measures recommended in Paragraph 7.2 should be accomplished within a reasonable period of time. The items recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II Inspection

Based on results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Alternatives

1. Spillway capacity and/or height of the dam should be increased to pass the PMF without overtopping the dam.

b. O & M Procedures

1. An extensive rehabilitation project should be undertaken for the spillway and the discharge channel to correct the structural instability and deterioration observed.

2. Determine the extent of damage done to the embankment by burrowing animals and make corrective repairs as required.

3. Remove the obstructions from the downstream channel.

4. Monitor the erosion observed on the upstream slope due to wave action and make corrective repairs as required.

5. Monitor the cracks observed on the downstream slope.

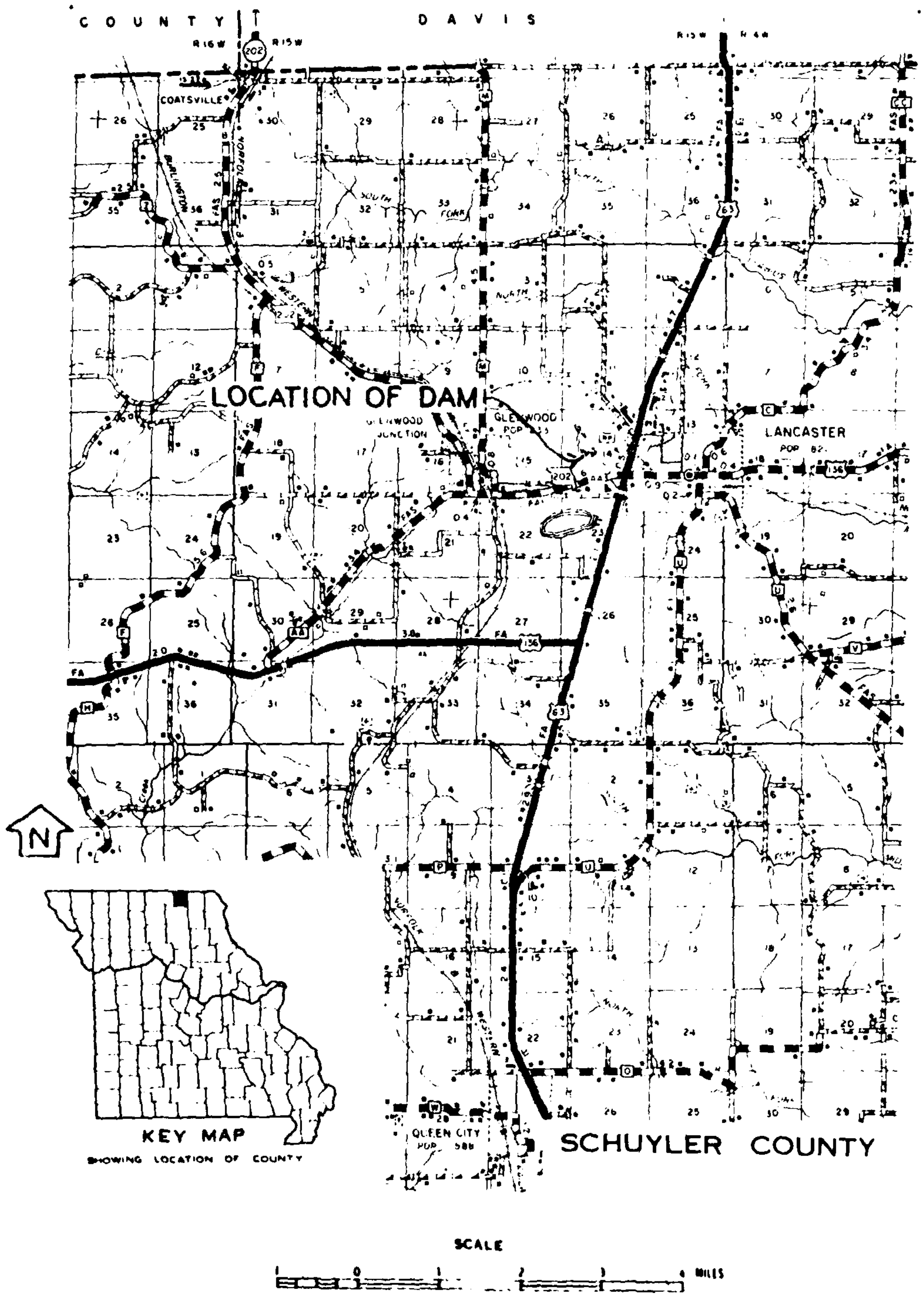
6. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of earth dams.

7. The owner should initiate the following programs:

   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.

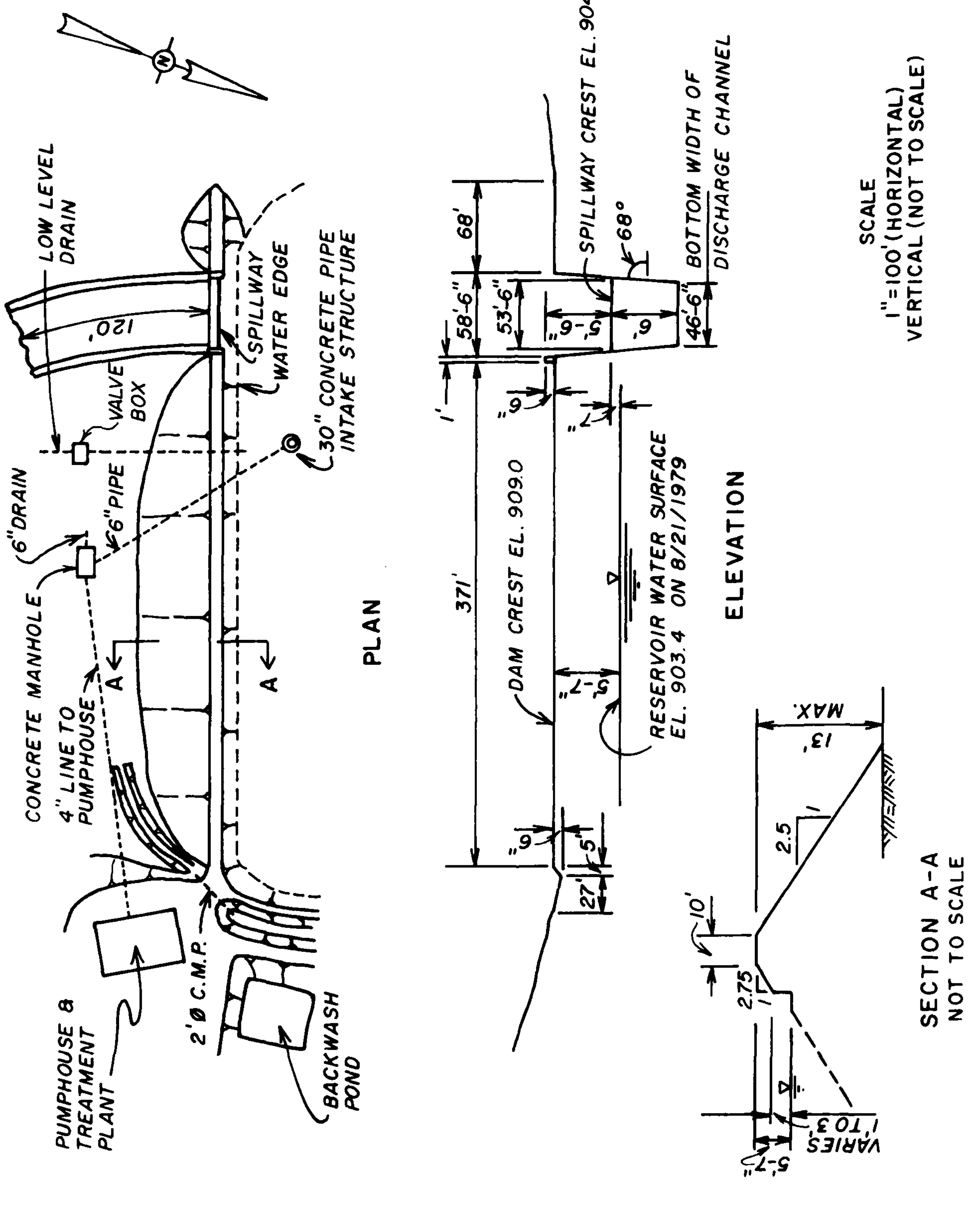
   (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

PLATES



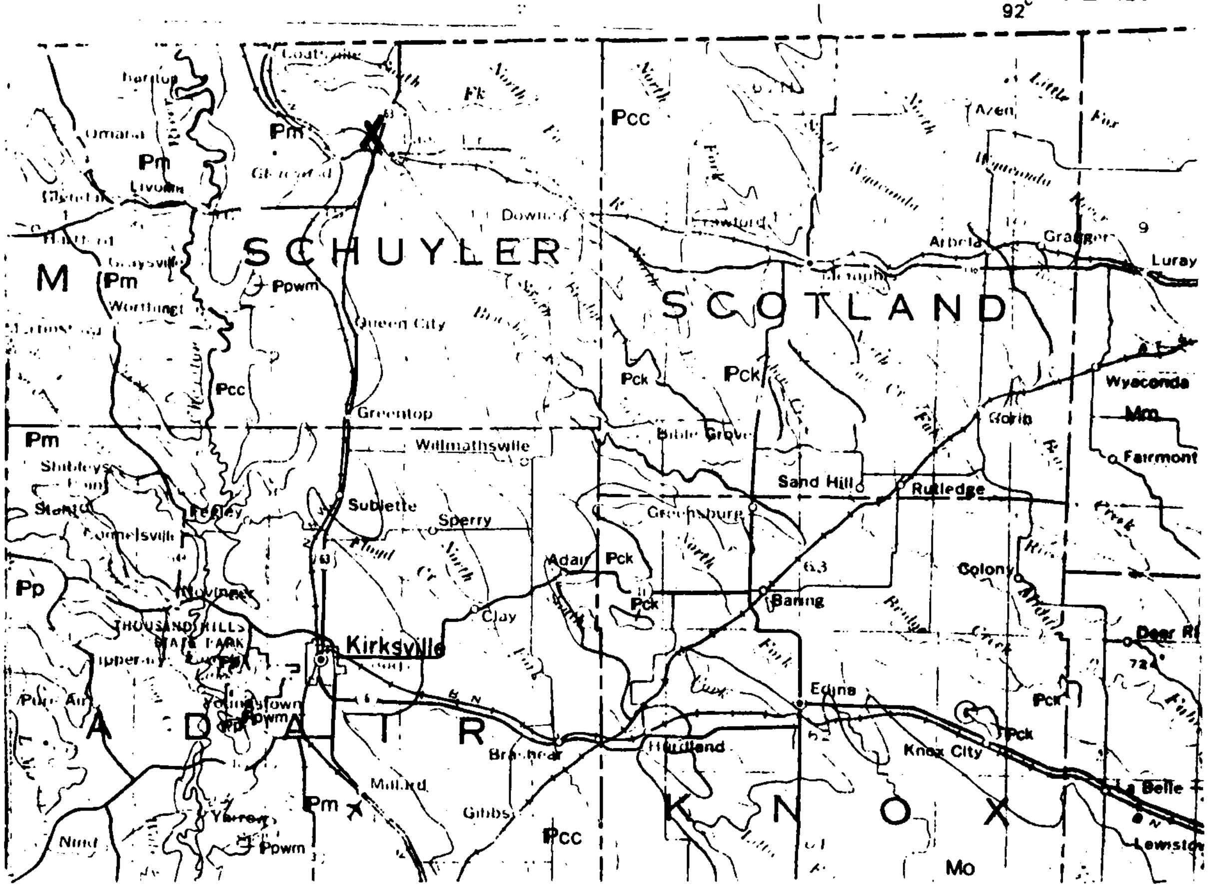
LOCATION MAP - LANCASTER CITY DAM

PLATE 2



LANCASTER CITY DAM (MO. 10851)
PLAN, ELEVATION & SECTION

PLATE 3

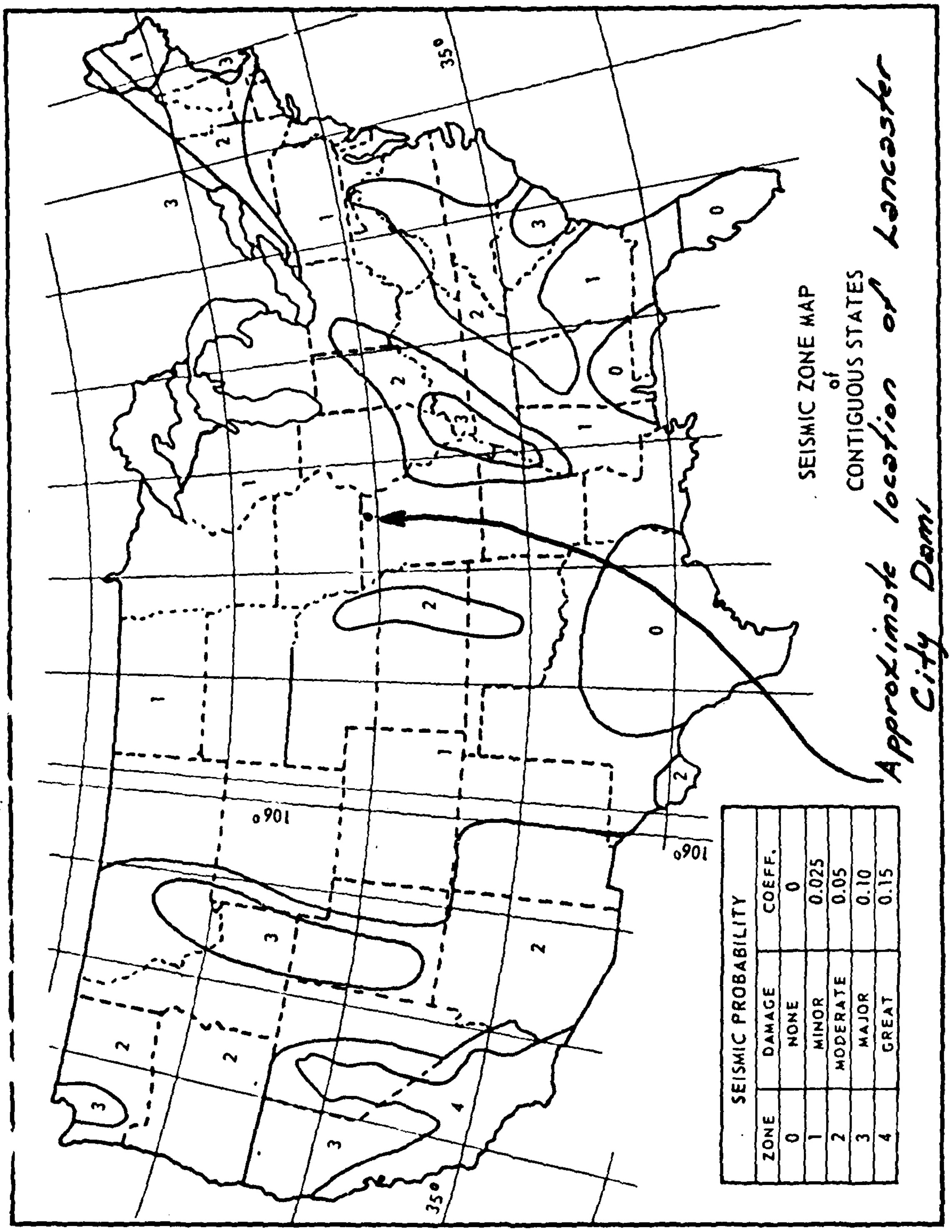


PENNSYLVANIAN	IPKc	- KANSAS CITY GROUP
	IPp	- PLEASANTON GROUP
	IPm	- MARMATON GROUP
	IPcc	- CHEROKEE GROUP, CABANISS SUBGROUP

X – LOCATION OF DAM, MO. 10851

REFERENCE:
GEOLOGIC MAP OF MISSOURI
MISSOURI GEOLOGIC SURVEY
1979

GEOLOGIC MAP OF SCHUYLER COUNTY AND ADJACENT AREA


SEISMIC ZONE MAP
of
CONTIGUOUS STATES
Approximate location of Lancaster City Dam
SEISMIC PROBABILITY
ZONE | DAMAGE | COEFF.
0 | NONE | 0
1 | MINOR | 0.025
2 | MODERATE | 0.05
3 | MAJOR | 0.10
4 | GREAT | 0.15
35°
106°

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

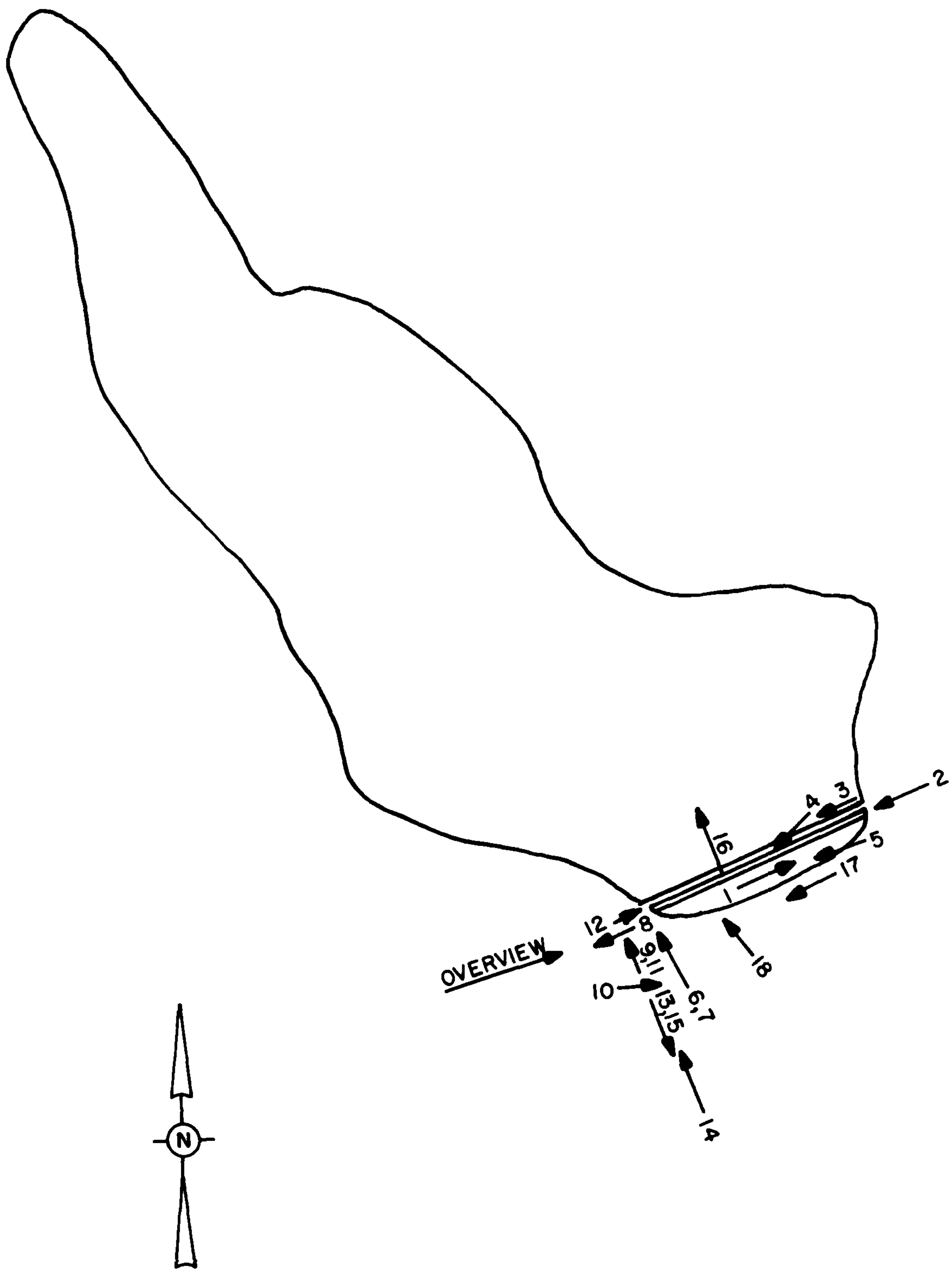


PHOTO INDEX
FOR
LANCASTER CITY DAM

Lancaster City Dam

Photo 1.	-	View of the downstream embankment slope.
Photo 2.	-	View of the crest.
Photo 3.	-	View of the upstream embankment slope.
Photo 4.	-	View of the riprap protection and typical scarp on the upstream slope.
Photo 5.	-	View of typical cracks on the downstream slope.
Photo 6.	-	View of the control section of the spillway from downstream. Note debris and vegetation in the discharge channel.
Photo 7.	-	Closeup view of the left side of the spillway weir. Note seepage along the weir and retaining wall contact and hole in which the discharge is flowing into the lower left hand corner.
Photo 8.	-	View along the spillway weir looking toward the right side. Note the construction joint along the weir.
Photo 9.	-	Closeup view of the right side of the spillway.
Photo 10.	-	View of one of the holes in the discharge channel slab. Note discharge into the hole.
Photo 11.	-	View of exposed reinforcement and spalling of the concrete in the discharge channel.
Photo 12.	-	View of the contact between the left side of the weir and the retaining wall from on top of the weir. Note how the concrete weir in the lower portion of the photo is tilted forward.

Lancaster City Dam

Photo 13.	-	View of the undermined and collapsed wall at the downstream end of the discharge channel.
Photo 14.	-	View of the undermining of the discharge channel slab.
Photo 15.	-	View of the debris and obstructions in the downstream channel.
Photo 16.	-	View of the reservoir rim.
Photo 17.	-	View of the concrete manhole which houses the control valves for the water supply system.
Photo 18.	-	View of the concrete box which houses the control valve for the low level drain.

Photo 1

Photo 2

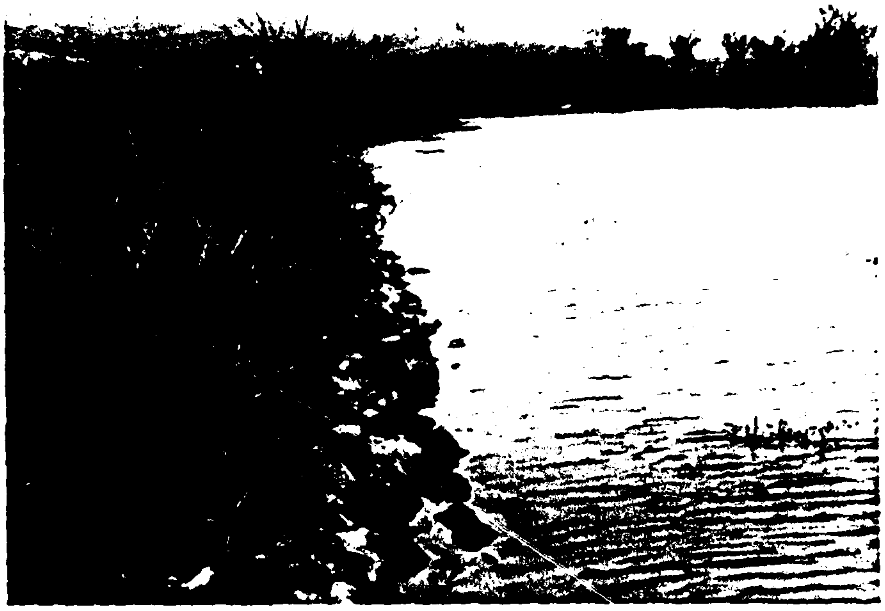


Photo 3

Photo 4

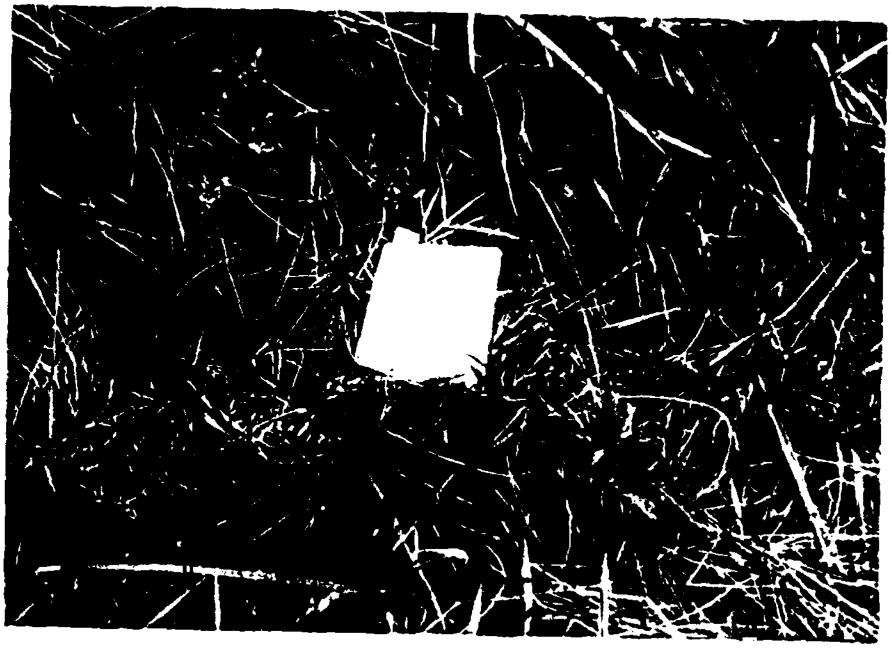


Photo 5

Photo 6

Photo 7

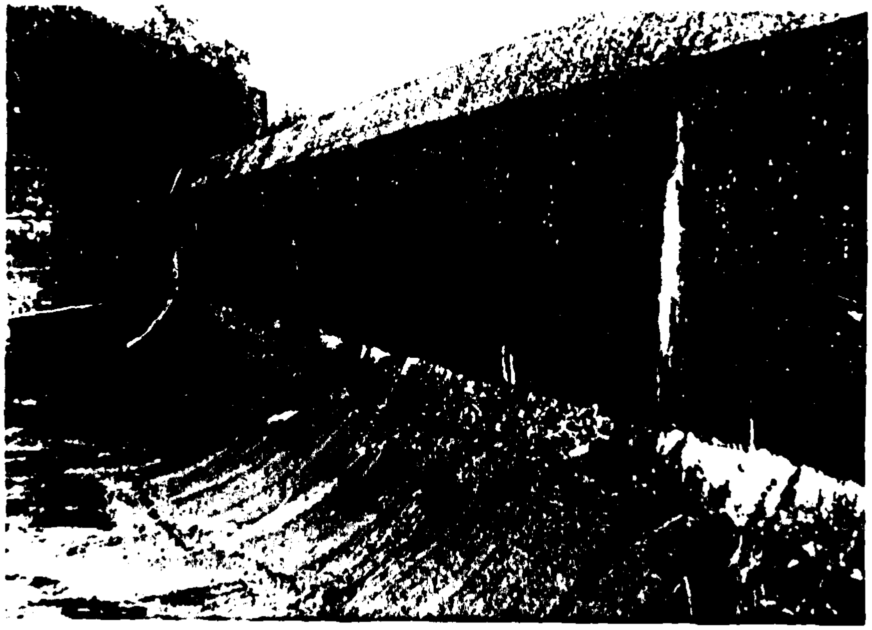


Photo 8

Photo 9

Photo 10

Photo 11

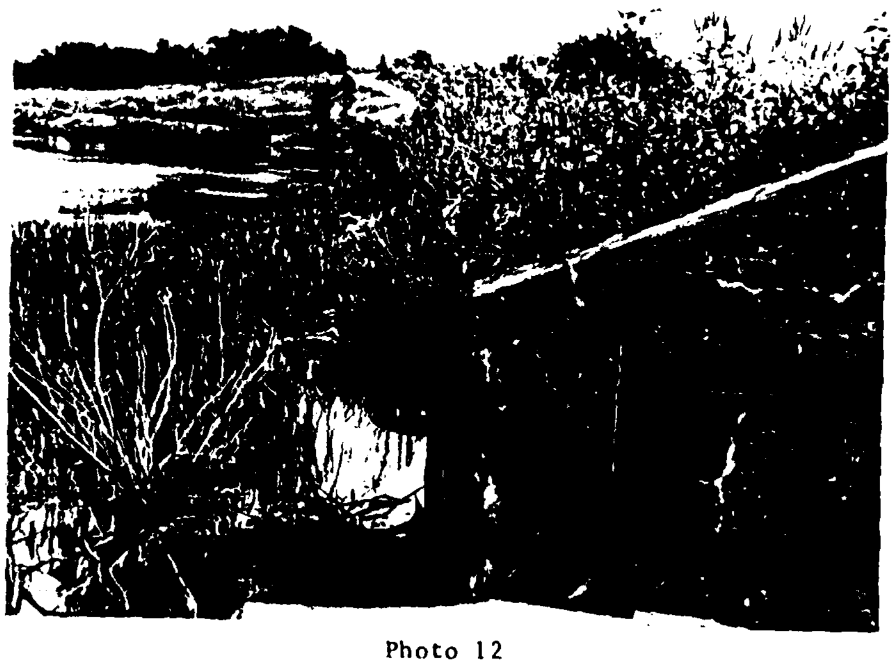


Photo 12

Photo 13

Photo 14

Photo 15

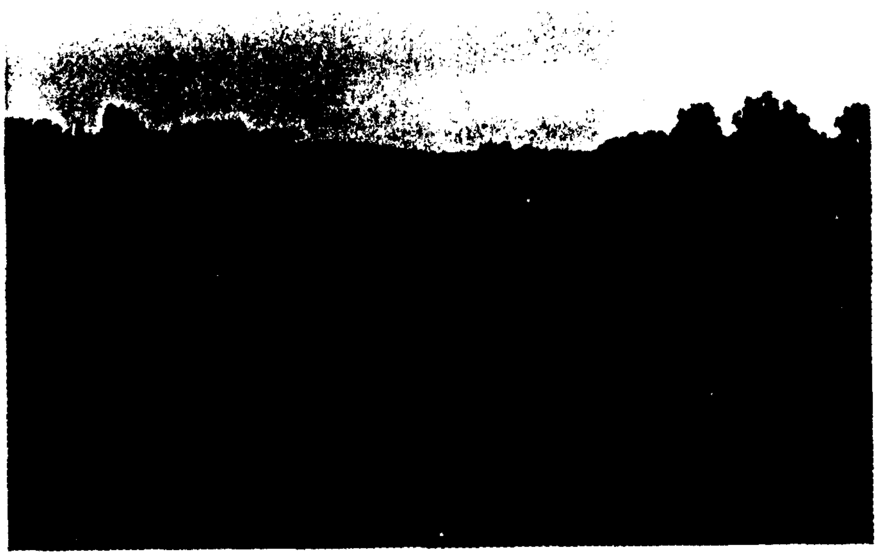


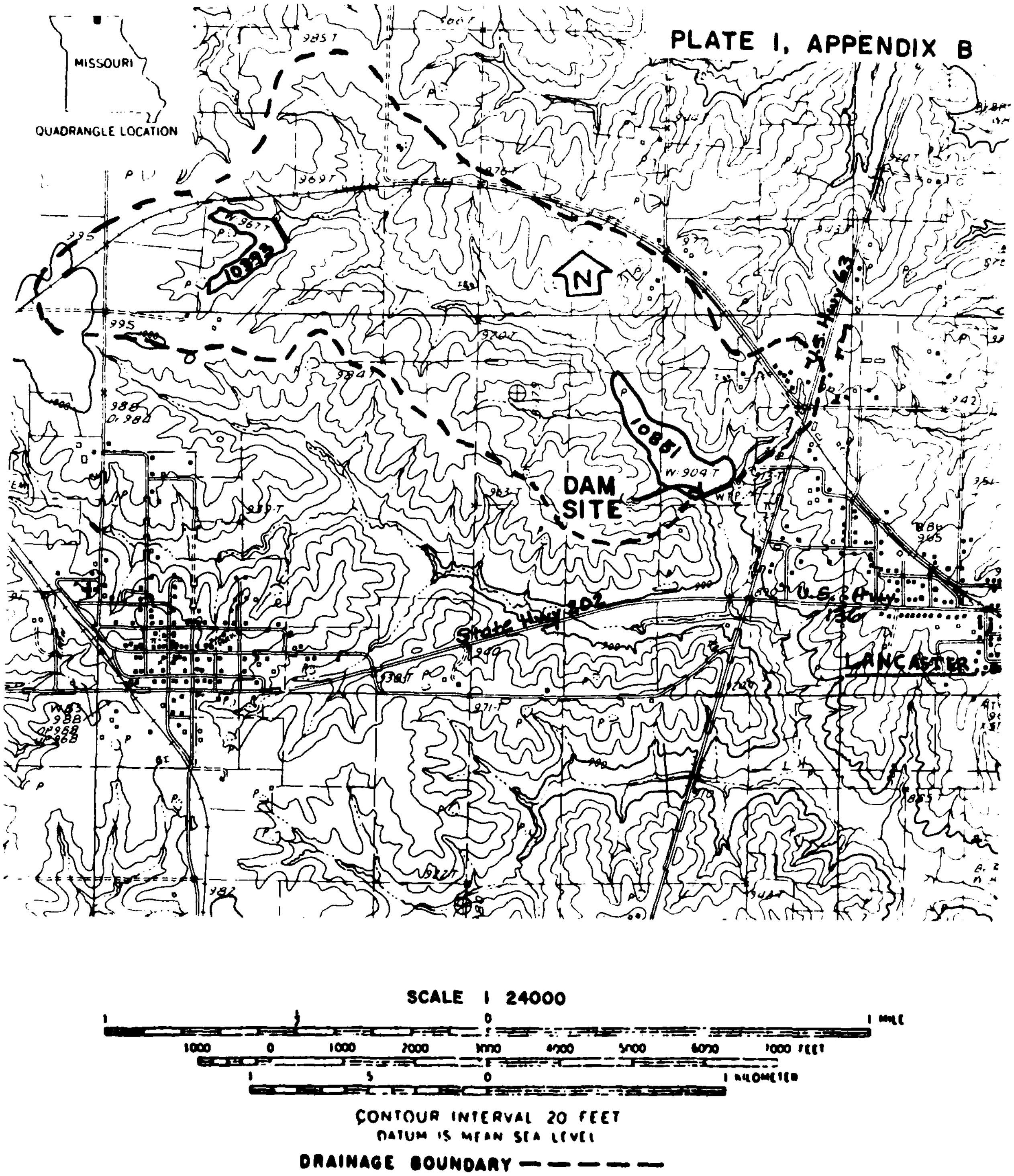
Photo 16

Photo 17

Photo 18

APPENDIX B

HYDROLOGIC COMPUTATIONS

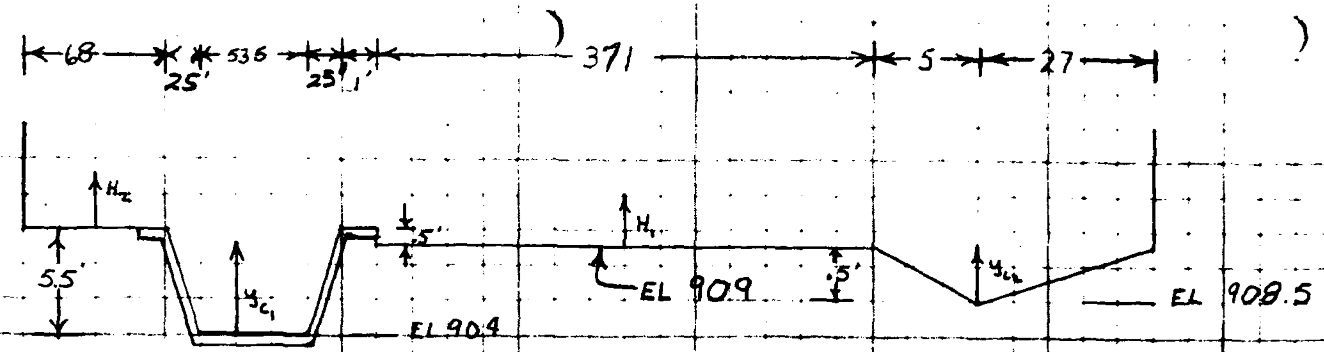


LANCASTER CITY DAM (MO 10851)
DRAINAGE BASIN

DAM SAFETY INSPECTION/MISSOURI — SHEET NO. 1 OF 3

LANCASTER CITY DAM (MO. 10851) — JOB NO. 1240

SPILLWAY & OVERTOP RATING CURVE — BY RHK — DATE 8-

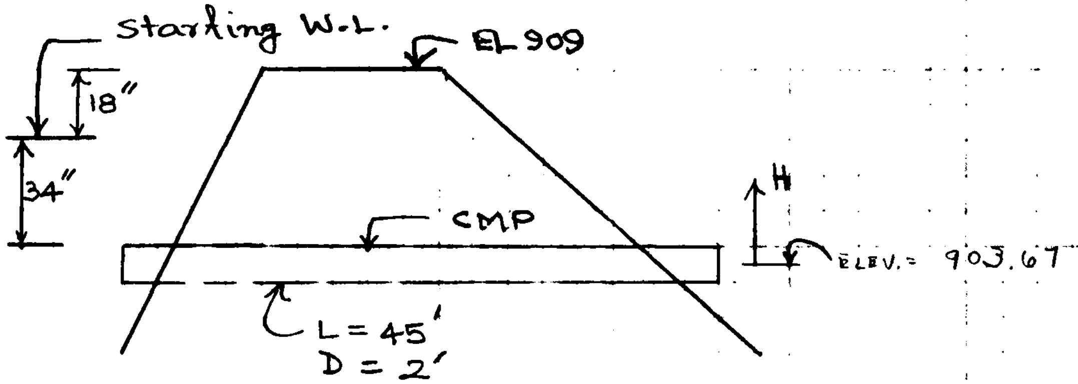


y_{c_1}	T_{c_1}	A_{c_1}	$V_c = 5.67\sqrt{A_c/T_{c_1}}$	$Q_{c_1} = V_{c_1} A_{c_1}$	U/S WS $= y_c + V^2/2g + 904$	$y_{c_2} = 2/3 \times$ (USWS − 908.5)	T_{c_2}	A_{c_2}	V_{c_2}	$Q_{c_2} = V_{c_2} A_{c_2}$	H_1	L_1	C_1	$Q_1 = C_1 L_1 H^{3/2}$	H_2	L_2	C_2	$Q_2 = C_2 L_2 H^{3/2}$	$Q_T = Q_1 + Q_2 + Q_{c_1} + Q_{c_2}$
0	-	-	-	0	904	-	-	-	-	-	-	-	-	-	-	-	-	-	0
2	55.3	108.8	7.95	865	906.98	-	-	-	-	-	-	-	-	-	-	-	-	-	865
2.5	55.8	136.6	8.87	1212	907.72	-	-	-	-	-	-	-	-	-	-	-	-	-	1212
3	56.2	164.6	9.70	1597	908.46	-	-	-	-	-	-	-	-	-	-	-	-	-	1597
4	57.1	221.3	11.16	2470	909.93	.95	32	22.4	4.74	106	.93	371	2.68	892	-	-	-	-	3468
5.5	58.5	308	13.01	4007	912.12	2.42	32	69.4	8.35	580	3.12	371	2.64	5098	2.62	69	2.64	773	10458
6.5	58.5	366.5	14.19	5201	913.62	3.41	32	101.1	10.08	1019	4.62	371	2.64	9726	4.12	69	2.64	1523	17469
8	58.5	459.25	15.80	7177	915.88	4.92	32	149.4	12.25	1831	6.88	371	2.64	17675	6.38	69	2.64	2936	29619

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 2 OF 3
LANCASTER CITY DAM (MO. 10851) — JOB NO. 1240-001
SPILLWAY & OVERTOP RATING CURVE — BY MAS DATE 8-31-

FLOW THROUGH THE CMP PIPE UNDER LEFT ABUTMENT

Water flows through this pipe when the reservoir level is only 1½ feet below the dam crest. This is because of a dike infront of the pipe.



Assume no tailwater effect, Thus.

$$H = \left(1 + K_e + \frac{29\, n^2 L}{R^{1.33}}\right)\frac{V^2}{2g}$$

Assume $K_e = 0.9$ & $n = 0.024$.

$$H = \left(1 + 0.9 + \frac{(0.024)^2(45)(29.1)}{R^{1.33}}\right)\cdot\frac{V^2}{2g} \qquad R = \tfrac{2}{4} = 0.5$$

$$\left(1 + 0.9 + \frac{.75}{.40}\right)\frac{V^2}{2g}$$

$$\left(1 + 0.9 + 1.88\right)\frac{V^2}{2g}$$

$$H = (3.78)\frac{V^2}{2g} \qquad V^2 = \frac{64.4}{3.78} H = 17.0\, H$$

$$V^2 = \frac{Q^2}{A^2}$$

$$\frac{Q^2}{A^2} = 17.\, H$$

$$Q^2 = 17 H A^2 = 17 \cdot 9.87 \cdot H = 168\, H$$

$$Q = 12.95\sqrt{H}$$

PRC ENGINEERING CONSULTANTS, INC.

[illegible] INSPECTION / MISSOURI — SHEET NO. 3 OF 3

LANCASTER CITY DAM (MO 10851) — JOB NO. 1240

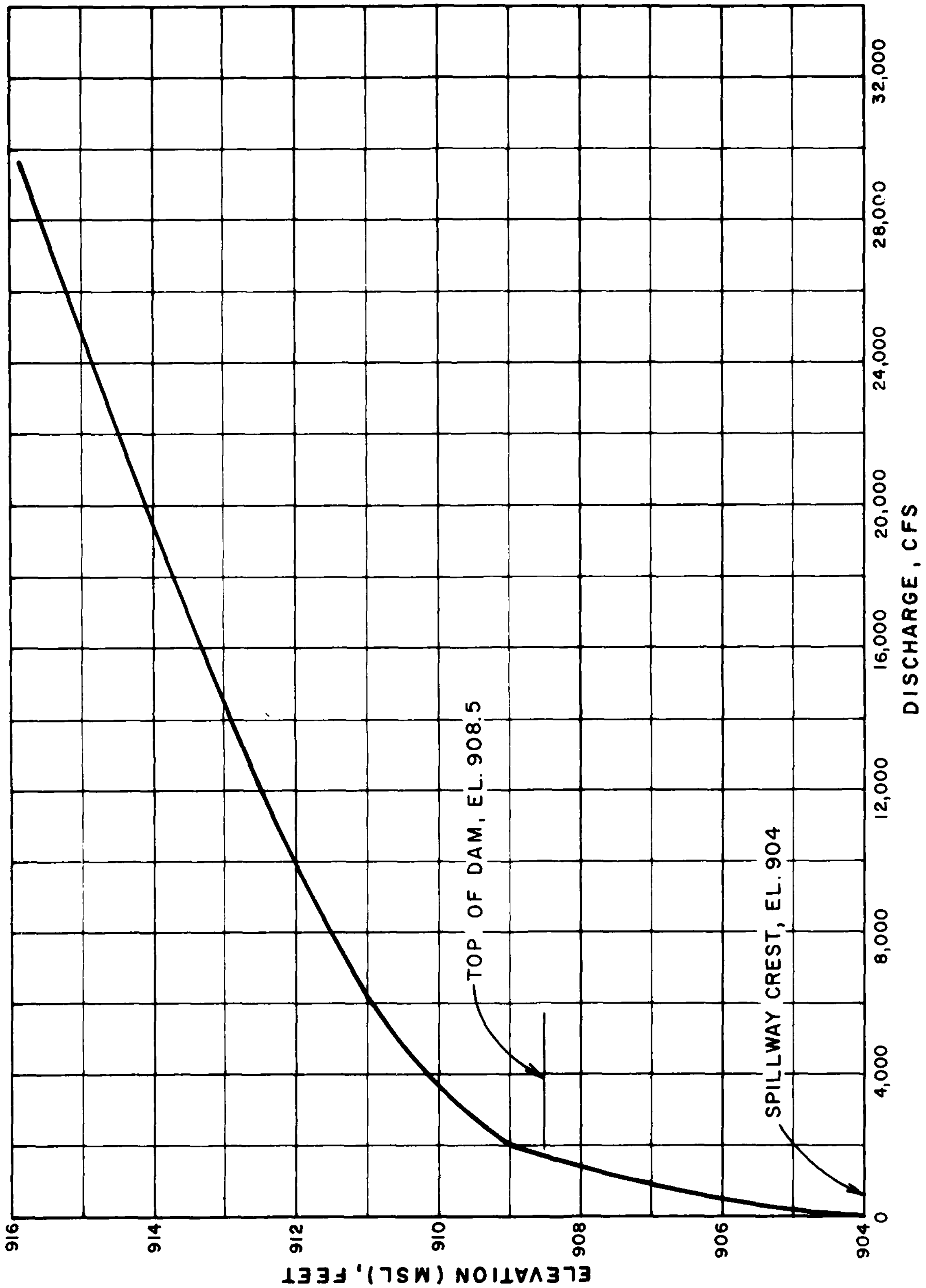
SPILLWAY AND OVERTOP RATING CURVE — BY [illegible] DATE [illegible]

LANCASTER CITY DAM (10851)

SPILLWAY AND OVERTOP DISCHARGE

U S WS ELEV	CMP DISCHARGE Q = 13.75√H	SPILLWAY AND OVERTOP DISCHARGE	TOTAL DISCHARGE	
904		—	0	SPILLWAY CREST
906.78	—	865	865	
907.72	26.0	1212	1238	
908.46	28.3	1597	1625	
909.93	32.4	3468	3500	
912.12	37.6	10458	10496	
913.62	40.8	17469	17510	
915.88	45.3	29619	29664	

PLATE 2 , APPENDIX B

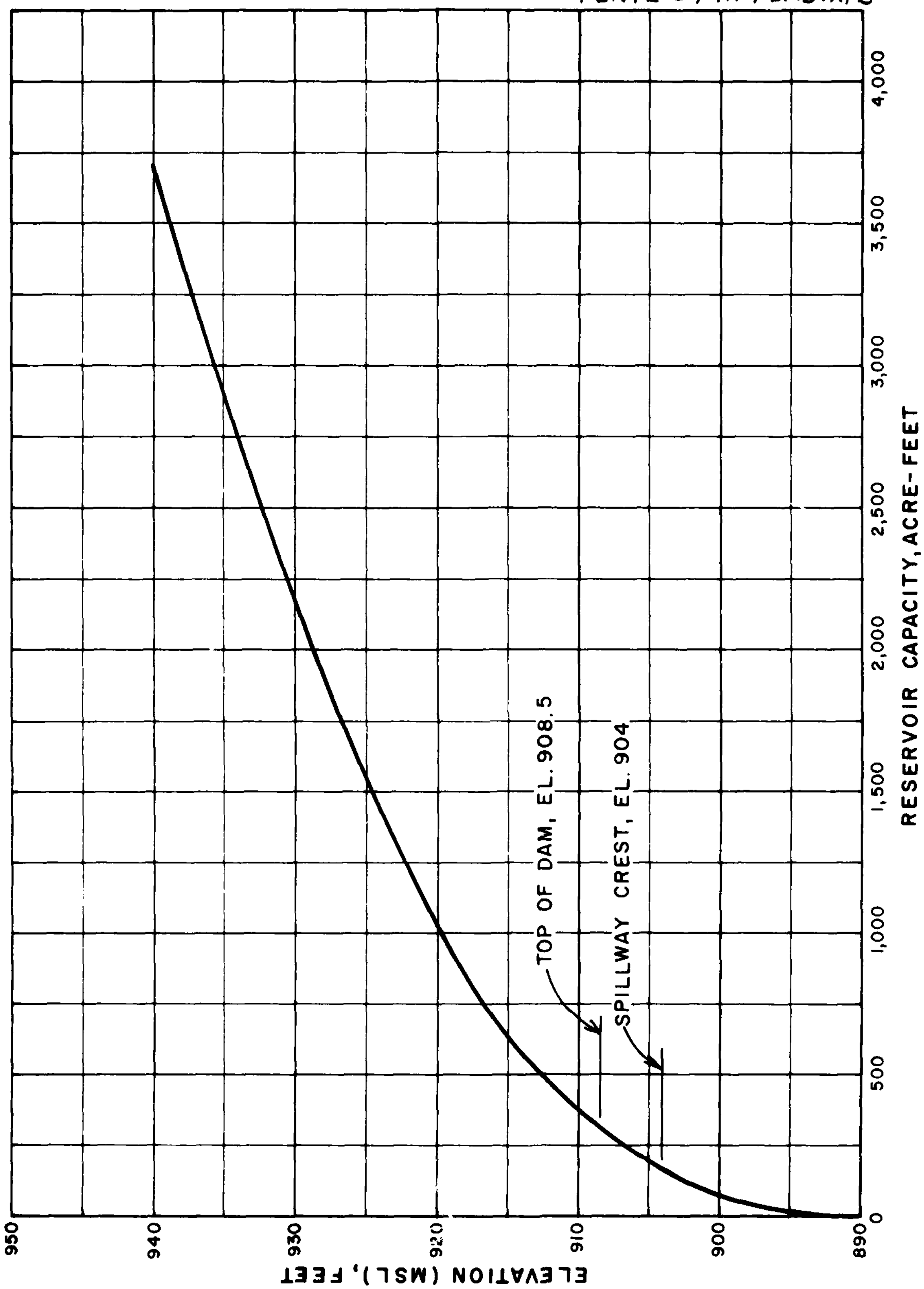


LANCASTER CITY DAM (MO. 10851)
SPILLWAY & OVERTOP RATING CURVE

LANCASTER CITY DAM (#10851)

RESERVOIR AREA CAPACITY

ELEV. M.S.L. (Ft)	RESERVOIR SURFACE AREA (ACRES)	INCREMENTAL VOLUME (AC-Ft)	TOTAL VOLUME (AC-Ft)	REMARKS
890	0	0	0	ESTIMATED STREAM BED AT CENTER OF DAM
904	32.3	151	151	SPILLWAY CREST
908.5	46	174	325	TOP OF DAM
909	47	23	348	
920	80.3	692	1040	
940	194.4	2664	3704	



LANCASTER CITY DAM (MO. 10851)
RESERVOIR CAPACITY CURVE

LANCASTER CITY DAM (#10851)

DETERMINATION OF PMP

1) DETERMINE AREA OF DRAINAGE BASIN

D. A. = 646 AC = 1.01 SQ. MI.

2) DETERMINE PMP INDEX RAINFALL
(200 SQ. MI., 24 HR DURATION)

LOCATION OF CENTEROID OF BASIN

LONGITUDE = 92° 33' 27"

LATITUDE = 40° 31' 58"

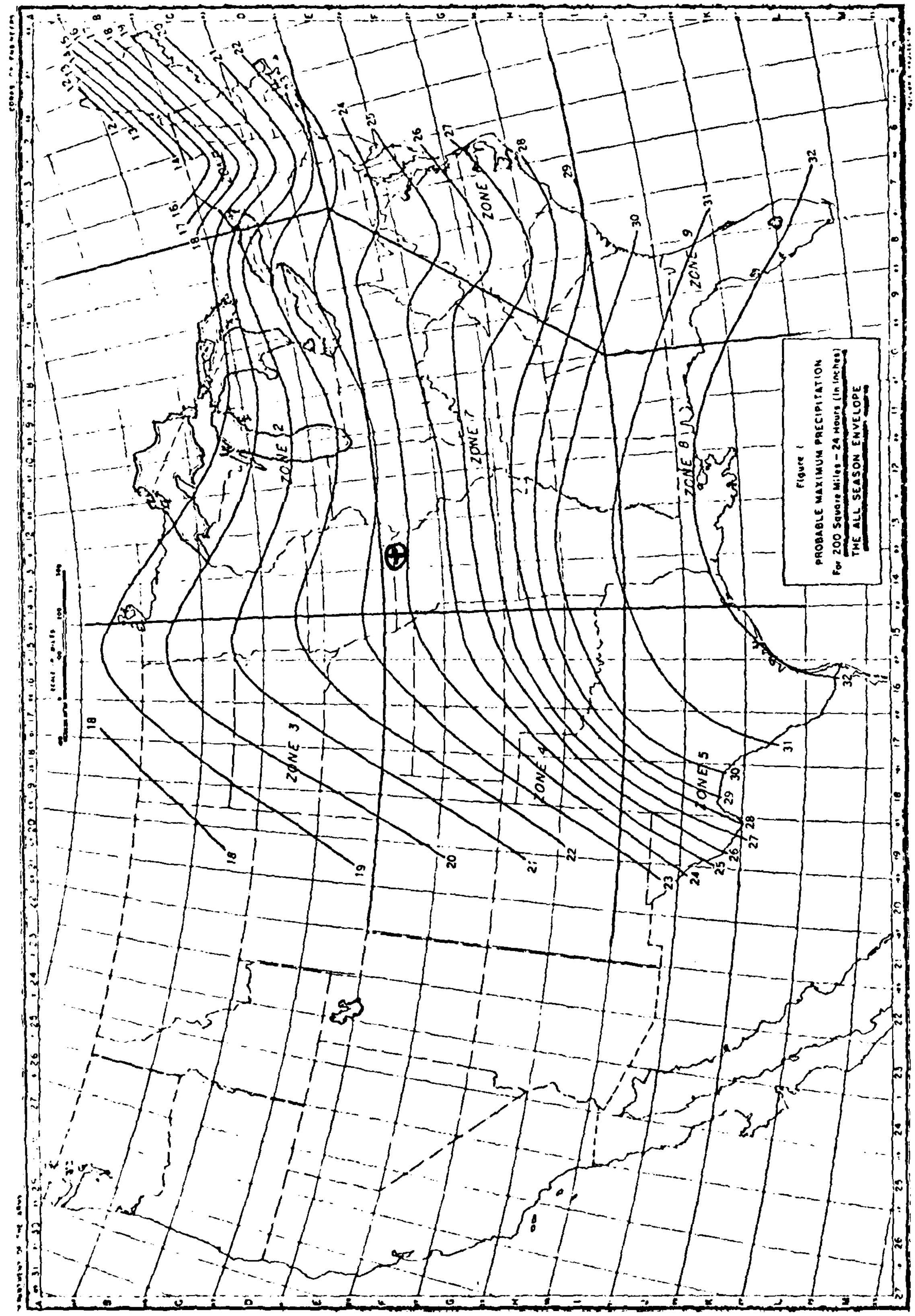
⇒ ZONE 7, PMP INDEX = 23.7"

3) DETERMINE BASIN RAINFALL IN TERMS OF PERCENTAGE OF PMP INDEX RAINFALL FOR VARIOUS DURATIONS:

LOCATION: LONGITUDE 92° 33' 27"

LATITUDE 40° 31' 58"

DURATION (HR.)	PERCENT OF INDEX RAINFALL %	TOTAL RAINFALL (IN)	RAINFALL INCREMENTS (IN)	DURATION OF INCREMENTS (HR)
6	100	23.7	23.7	6
12	120	28.4	4.7	6
24	130	30.8	2.4	12



LANCASTER CITY DAM
(PA 00251)

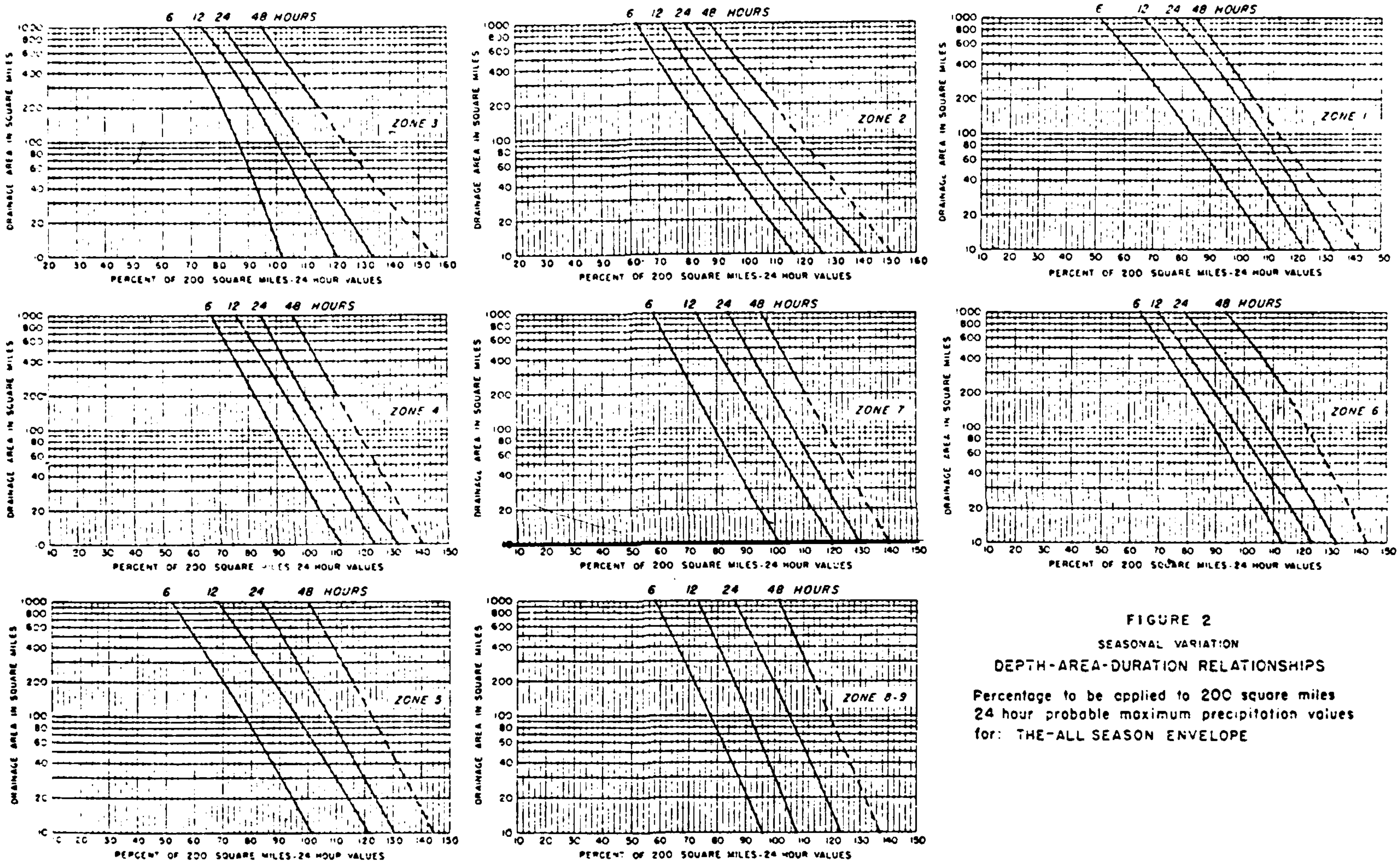


FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles
24 hour probable maximum precipitation values
for: THE-ALL SEASON ENVELOPE

1) DRAINAGE AREA = 646 AC = 1.01 SQ. MI.

2) LENGTH OF STREAM, L = (3.8 × 2000) = 7600 ft = 1.44 mi

3) ELEVATION OF DRAINAGE DIVIDE ALONG THE LONGEST STREAM = H_1 = 984 ft

4) RESERVOIR ELEVATION AT SPILLWAY CREST = H_2 = 904 ft

5) DIFFERENCE IN ELEVATION = $\Delta H = H_1 - H_2 = 984 - 904 = 80$ ft

6) AVERAGE SLOPE OF STREAM = $\frac{\Delta H}{L} = \frac{80}{7600} = 1.05\%$

7) TIME OF CONCENTRATION:

a) BY KIRPICH FORMULA,

$$T_c = \left(\frac{11.9 \times L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.9 \times 1.44^3}{80}\right)^{0.385}$$

T_c = 0.73 HR

b) BY VELOCITY ESTIMATE:

AVERAGE SLOPE = 1.44% ⇒ V = 2.0 FPS

$$T_c = \frac{L}{V} = \frac{7600}{2 \times 3600} = 1.05 \text{ HR}$$

USE T_c = 0.73 HR

8) LAG TIME = $0.6 \times T_c = 0.6 \times 0.73 = 0.44$ HR

9) UNIT DURATION $D \le \frac{Lt}{4} = \frac{0.44}{4} = 0.11$ HR

USE D = 5 MIN = 0.083 HR

10) TIME TO PEAK, $T_p = \frac{D}{2} + L_t = \frac{0.083}{2} + 0.44 = 0.48$ HR

11) PEAK DISCHARGE, $q_p = \frac{484 \times A}{T_p} = \frac{484 \times 1.01}{0.48}$

q_p = 1018

LANCASTER CITY DAM (10851)

HYDROLOGIC SOIL GROUP AND CURVE NUMBER

1. WATERSHED SOILS IN THIS BASIN CONSIST PRIMARILY OF GROUP D AND SOME GROUP C SOILS, ASSUME GROUP D FOR THE ENTIRE WATERSHED.

2. THIS WATERSHED IS MOSTLY PASTURE LAND
ASSUME THE HYDROLOGIC CONDITION OF THIS WATERSHED IS "FAIR".

THUS CN = 84 for Group 'D' SOILS
WITH AMC II

⇒ CN = 93 WITH AMC III

MISSOURI DAM 10851

100 YEAR FLOOD BY REGRESSION EQUATION

REGRESSION EQUATION FOR THE 100 YEAR FLOOD FOR MISSOURI

$$Q_{100} = 85.1\,A^{0.934\,A^{-0.02}}\,S^{0.576}$$

WHERE:

A = DRAINAGE AREA in Sq Mi

S = MAIN CHANNEL SLOPE Ft/mi
(AVG. SLOPE BETWEEN 0.1L AND 0.85L)

FOR MISSOURI DAM 10851

A = 1.01 Sq. Mi.

S = 43.52 Ft/mi

$$Q_{100} = 85.1\,(1.01)^{0.934\,(1.01)^{-0.02}}\,(43.52)^{0.576}$$

$$= \underline{755 \text{ CFS.}}$$

HEC1DB INPUT DATA

```
*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
*************************************
A1                    DAM SAFETY INSPECTION - MISSOURI
A2                     LANCASTER CITY DAM (MO.10851)
A3                      PMF AND 50 PERCENT PMF
B    300       0       5       0       0       0       0       0       0       0
B1     5
J      1       2       1
J1     1      .5
K      0   10393
K1  INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS
M      1       2    0.20            0.20       1
P           23.7     100     120     130
T                                                      -1     -93
W2           .19
X      0       0       1
K      1   10393
K1  ROUTE HYDROGRAPH THROUGH URSEL GINGERICH DAM
Y                              1       1
Y1                                                   -967      -1
Y4   967   969.8  970.27  971.34  971.69  973.13  976.13  979.13
Y5     0      17     217     560    1312    4240   15538   30951
$S     0      46      96     303
$E   955     967   970.3     980
$$   967
$D 970.3
K      0   10851
K1  INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS
M      1       2    1.01            1.01       1
P           23.7     100     120     130
T                                                      -1     -93
W2           .44
X      0       0       1
K      2   10851
K1     COMBINE HYDROGRAPHS BEFORE LANCASTER CITY LAKE ROUTING
K      1   10851
K1  ROUTE COMBINED HYDROGRAPH THROUGH LANCASTER CITY DAM
Y                              1       1
Y1                                                   -904      -1
Y4   904  906.98  907.72  908.46  909.00  909.93  912.12  913.62  915.88
Y5     0     866    1238    1625    2000    3500   10496   17510   29664
$S     0     151     325     548    1040    3704
$E   893     904   908.5     909     920     940
$$   904
$D 908.5
K     99
```

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT          10393
ROUTE HYDROGRAPH TO           10393
RUNOFF HYDROGRAPH AT          10851
COMBINE 2 HYDROGRAPHS AT      10851
ROUTE HYDROGRAPH TO           10851
END OF NETWORK
```

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*********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
*********************************

RUN  DATE: 79/10/09.
     TIME: 13.44.41.

                              DAM SAFETY INSPECTION - MISSOURI
                                LANCASTER CITY DAM (MO.10851)
                                 PMF AND 50 PERCENT PMF

                                    JOB SPECIFICATION
          NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         300        0        6        0        0        0        0        0        0        0
                                   JOPER      NWT    LROPT    TRACE
                                       5        0        0        0

                              MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 2 LRTIO= 1
          RTIOS=   1.00     .50

  **********        **********        **********        **********        **********

                                 SUB-AREA RUNOFF COMPUTATION

         INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS

                        ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        10333       0       0       0       0       0       0       0       0

                                       HYDROGRAPH DATA
          IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1      2     .20    0.00     .20    1.00   0.000       0       0       0

                                        PRECIP DATA
               SPFE     PMS      R6     R12     R24     R48     R72     R96
               0.00   23.70  100.00  120.00  130.00    0.00    0.00    0.00

                                         LOSS DATA
       LROPT  STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
           0   0.00   0.00   1.00   0.00   0.00   1.00  -1.00 -93.00   0.00   0.00

         CURVE NO = -93.00  WETNESS =  -1.00  EFFECT CN =  93.00

                                     UNIT HYDROGRAPH DATA
                                TC=  0.00     LAG=   .19

                                       RECESSION DATA
                        STRTQ=    0.00   QRCSN=   0.00   RTIOR= 1.00

         UNIT HYDROGRAPH 13 END OF PERIOD ORDINATES, TC=   0.00 HOURS, LAG=    .19  VOL= 1.00
     189.     350.     413.     308.     163.      92.      51.      28.      16.       9.
       5.       3.       1.
```

B-19

END-OF-PERIOD FLOW

B MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.35	151	.20	.20	.00	294.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.40	152	.20	.20	.00	298.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.45	153	.20	.20	.00	300.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.50	154	.20	.20	.00	302.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.55	155	.20	.20	.00	302.
1.01	.30	6	.01	0.00	.01	0.	1.01	13.00	156	.20	.20	.00	303.
1.01	.35	7	.01	0.00	.01	0.	1.01	13.05	157	.24	.24	.00	307.
1.01	.40	8	.01	0.00	.01	0.	1.01	13.10	158	.24	.24	.00	321.
1.01	.45	9	.01	0.00	.01	0.	1.01	13.15	159	.24	.24	.00	338.
1.01	.50	10	.01	0.00	.01	0.	1.01	13.20	160	.24	.24	.00	350.
1.01	.55	11	.01	0.00	.01	0.	1.01	13.25	161	.24	.24	.00	356.
1.01	1.00	12	.01	.00	.01	0.	1.01	13.30	162	.24	.24	.00	360.
1.01	1.05	13	.01	.00	.01	0.	1.01	13.35	163	.24	.24	.00	362.
1.01	1.10	14	.01	.00	.01	0.	1.01	13.40	164	.24	.24	.00	363.
1.01	1.15	15	.01	.00	.01	1.	1.01	13.45	165	.24	.24	.00	364.
1.01	1.20	16	.01	.00	.01	1.	1.01	13.50	166	.24	.24	.00	365.
1.01	1.25	17	.01	.00	.01	2.	1.01	13.55	167	.24	.24	.00	365.
1.01	1.30	18	.01	.00	.01	2.	1.01	14.00	168	.24	.24	.00	365.
1.01	1.35	19	.01	.00	.01	3.	1.01	14.05	169	.30	.30	.00	372.
1.01	1.40	20	.01	.00	.01	3.	1.01	14.10	170	.30	.30	.00	392.
1.01	1.45	21	.01	.00	.01	4.	1.01	14.15	171	.30	.30	.00	417.
1.01	1.50	22	.01	.00	.01	4.	1.01	14.20	172	.30	.30	.00	435.
1.01	1.55	23	.01	.00	.01	5.	1.01	14.25	173	.30	.30	.00	445.
1.01	2.00	24	.01	.00	.01	5.	1.01	14.30	174	.30	.30	.00	450.
1.01	2.05	25	.01	.00	.01	6.	1.01	14.35	175	.30	.30	.00	453.
1.01	2.10	26	.01	.00	.01	6.	1.01	14.40	176	.30	.30	.00	455.
1.01	2.15	27	.01	.00	.01	7.	1.01	14.45	177	.30	.30	.00	456.
1.01	2.20	28	.01	.01	.01	7.	1.01	14.50	178	.30	.30	.00	457.
1.01	2.25	29	.01	.01	.01	7.	1.01	14.55	179	.30	.30	.00	457.
1.01	2.30	30	.01	.01	.01	8.	1.01	15.00	180	.30	.30	.00	457.
1.01	2.35	31	.01	.01	.01	8.	1.01	15.05	181	.18	.18	.00	445.
1.01	2.40	32	.01	.01	.01	8.	1.01	15.10	182	.36	.36	.00	424.
1.01	2.45	33	.01	.01	.01	9.	1.01	15.15	183	.36	.36	.00	439.
1.01	2.50	34	.01	.01	.01	9.	1.01	15.20	184	.54	.54	.00	497.
1.01	2.55	35	.01	.01	.01	9.	1.01	15.25	185	.63	.63	.00	506.
1.01	3.00	36	.01	.01	.01	10.	1.01	15.30	186	1.53	1.53	.00	828.
1.01	3.05	37	.01	.01	.01	10.	1.01	15.35	187	2.52	2.52	.00	1354.
1.01	3.10	38	.01	.01	.01	10.	1.01	15.40	188	.99	.99	.00	1967.
1.01	3.15	39	.01	.01	.01	10.	1.01	15.45	189	.63	.63	.00	2113.
1.01	3.20	40	.01	.01	.01	11.	1.01	15.50	190	.54	.54	.00	1818.
1.01	3.25	41	.01	.01	.01	11.	1.01	15.55	191	.36	.36	.00	1402.
1.01	3.30	42	.01	.01	.01	11.	1.01	16.00	192	.36	.36	.00	1086.
1.01	3.35	43	.01	.01	.01	11.	1.01	16.05	193	.28	.28	.00	855.
1.01	3.40	44	.01	.01	.01	11.	1.01	16.10	194	.28	.28	.00	698.
1.01	3.45	45	.01	.01	.01	12.	1.01	16.15	195	.28	.28	.00	579.
1.01	3.50	46	.01	.01	.01	12.	1.01	16.20	196	.28	.28	.00	511.
1.01	3.55	47	.01	.01	.01	12.	1.01	16.25	197	.28	.28	.00	474.
1.01	4.00	48	.01	.01	.00	12.	1.01	16.30	198	.28	.28	.00	453.
1.01	4.05	49	.01	.01	.00	12.	1.01	16.35	199	.28	.28	.00	441.
1.01	4.10	50	.01	.01	.00	13.	1.01	16.40	200	.28	.28	.00	433.
1.01	4.15	51	.01	.01	.00	13.	1.01	16.45	201	.28	.28	.00	430.
1.01	4.20	52	.01	.01	.00	13.	1.01	16.50	202	.28	.28	.00	429.
1.01	4.25	53	.01	.01	.00	13.	1.01	16.55	203	.28	.28	.00	428.
1.01	4.30	54	.01	.01	.00	13.	1.01	17.00	204	.28	.28	.00	428.
1.01	4.35	55	.01	.01	.00	13.	1.01	17.05	205	.22	.22	.00	421.
1.01	4.40	56	.01	.01	.00	14.	1.01	17.10	206	.22	.22	.00	401.

1.01	4.45	57	.01	.01	.00	14.	1.01	17.15	207	.22	.22	.00	376.
1.01	4.50	58	.01	.01	.00	14.	1.01	17.20	208	.22	.22	.00	358.
1.01	4.55	59	.01	.01	.00	14.	1.01	17.25	209	.22	.22	.00	348.
1.01	5.00	60	.01	.01	.00	14.	1.01	17.30	210	.22	.22	.00	343.
1.01	5.05	61	.01	.01	.00	14.	1.01	17.35	211	.22	.22	.00	340.
1.01	5.10	62	.01	.01	.00	14.	1.01	17.40	212	.22	.22	.00	338.
1.01	5.15	63	.01	.01	.00	14.	1.01	17.45	213	.22	.22	.00	337.
1.01	5.20	64	.01	.01	.00	15.	1.01	17.50	214	.22	.22	.00	337.
1.01	5.25	65	.01	.01	.00	15.	1.01	17.55	215	.22	.22	.00	336.
1.01	5.30	66	.01	.01	.00	15.	1.01	18.00	216	.22	.22	.00	336.
1.01	5.35	67	.01	.01	.00	15.	1.01	18.05	217	.02	.02	.00	315.
1.01	5.40	68	.01	.01	.00	15.	1.01	18.10	218	.02	.02	.00	246.
1.01	5.45	69	.01	.01	.00	15.	1.01	18.15	219	.02	.02	.00	164.
1.01	5.50	70	.01	.01	.00	15.	1.01	18.20	220	.02	.02	.00	103.
1.01	5.55	71	.01	.01	.00	15.	1.01	18.25	221	.02	.02	.00	71.
1.01	6.00	72	.01	.01	.00	15.	1.01	18.30	222	.02	.02	.00	63.
1.01	6.05	73	.07	.05	.01	20.	1.01	18.35	223	.02	.02	.00	43.
1.01	6.10	74	.07	.05	.01	34.	1.01	18.40	224	.02	.02	.00	37.
1.01	6.15	75	.07	.05	.01	52.	1.01	18.45	225	.02	.02	.00	34.
1.01	6.20	76	.07	.05	.01	65.	1.01	18.50	226	.02	.02	.00	32.
1.01	6.25	77	.07	.05	.01	73.	1.01	18.55	227	.02	.02	.00	31.
1.01	6.30	78	.07	.05	.01	74.	1.01	19.00	228	.02	.02	.00	31.
1.01	6.35	79	.07	.06	.01	82.	1.01	19.05	229	.02	.02	.00	31.
1.01	6.40	80	.07	.06	.01	84.	1.01	19.10	230	.02	.02	.00	31.
1.01	6.45	81	.07	.06	.01	86.	1.01	19.15	231	.02	.02	.00	31.
1.01	6.50	82	.07	.06	.01	87.	1.01	19.20	232	.02	.02	.00	31.
1.01	6.55	83	.07	.06	.01	88.	1.01	19.25	233	.02	.02	.00	31.
1.01	7.00	84	.07	.06	.01	89.	1.01	19.30	234	.02	.02	.00	31.
1.01	7.05	85	.07	.06	.01	90.	1.01	19.35	235	.02	.02	.00	31.
1.01	7.10	86	.07	.06	.01	91.	1.01	19.40	236	.02	.02	.00	31.
1.01	7.15	87	.07	.06	.01	91.	1.01	19.45	237	.02	.02	.00	31.
1.01	7.20	88	.07	.06	.01	92.	1.01	19.50	238	.02	.02	.00	31.
1.01	7.25	89	.07	.06	.01	92.	1.01	19.55	239	.02	.02	.00	31.
1.01	7.30	90	.07	.06	.01	93.	1.01	20.00	240	.02	.02	.00	31.
1.01	7.35	91	.07	.06	.00	93.	1.01	20.05	241	.02	.02	.00	31.
1.01	7.40	92	.07	.06	.00	94.	1.01	20.10	242	.02	.02	.00	31.
1.01	7.45	93	.07	.05	.00	94.	1.01	20.15	243	.02	.02	.00	31.
1.01	7.50	94	.07	.06	.00	94.	1.01	20.20	244	.02	.02	.00	31.
1.01	7.55	95	.07	.06	.00	95.	1.01	20.25	245	.02	.02	.00	31.
1.01	8.00	96	.07	.06	.00	95.	1.01	20.30	246	.02	.02	.00	31.
1.01	8.05	97	.07	.06	.00	95.	1.01	20.35	247	.02	.02	.00	31.
1.01	8.10	98	.07	.06	.00	95.	1.01	20.40	248	.02	.02	.00	31.
1.01	8.15	99	.07	.06	.00	96.	1.01	20.45	249	.02	.02	.00	31.
1.01	8.20	100	.07	.06	.00	96.	1.01	20.50	250	.02	.02	.00	31.
1.01	8.25	101	.07	.06	.00	96.	1.01	20.55	251	.02	.02	.00	31.
1.01	8.30	102	.07	.06	.00	97.	1.01	21.00	252	.02	.02	.00	31.
1.01	8.35	103	.07	.06	.00	97.	1.01	21.05	253	.02	.02	.00	31.
1.01	8.40	104	.07	.06	.00	97.	1.01	21.10	254	.02	.02	.00	31.
1.01	8.45	105	.07	.06	.00	97.	1.01	21.15	255	.02	.02	.00	31.
1.01	8.50	106	.07	.06	.00	97.	1.01	21.20	256	.02	.02	.00	31.
1.01	8.55	107	.07	.06	.00	98.	1.01	21.25	257	.02	.02	.00	31.
1.01	9.00	108	.07	.06	.00	98.	1.01	21.30	258	.02	.02	.00	31.
1.01	9.05	109	.07	.06	.00	98.	1.01	21.35	259	.02	.02	.00	31.
1.01	9.10	110	.07	.06	.00	98.	1.01	21.40	260	.02	.02	.00	31.
1.01	9.15	111	.07	.06	.00	98.	1.01	21.45	261	.02	.02	.00	31.
1.01	9.20	112	.07	.06	.00	98.	1.01	21.50	262	.02	.02	.00	31.
1.01	9.25	113	.07	.06	.00	98.	1.01	21.55	263	.02	.02	.00	31.
1.01	9.30	114	.07	.06	.00	98.	1.01	22.00	264	.02	.02	.00	31.
1.01	9.35	115	.07	.06	.00	99.	1.01	22.05	265	.02	.02	.00	31.
1.01	9.40	116	.07	.06	.00	99.	1.01	22.10	266	.02	.02	.00	31.

1.01	9.45	117	.07	.06	.00	97.	1.01	22.15	267	.02	.02	.00	31.
1.01	9.50	118	.07	.06	.00	99.	1.01	22.20	268	.02	.02	.00	31.
1.01	9.55	119	.07	.06	.00	99.	1.01	22.25	269	.02	.02	.00	31.
1.01	10.00	120	.07	.06	.00	99.	1.01	22.30	270	.02	.02	.00	31.
1.01	10.05	121	.07	.06	.00	99.	1.01	22.35	271	.02	.02	.00	31.
1.01	10.10	122	.07	.06	.00	99.	1.01	22.40	272	.02	.02	.00	31.
1.01	10.15	123	.07	.05	.00	99.	1.01	22.45	273	.02	.02	.00	31.
1.01	10.20	124	.07	.06	.00	99.	1.01	22.50	274	.02	.02	.00	31.
1.01	10.25	125	.07	.06	.00	99.	1.01	22.55	275	.02	.02	.00	31.
1.01	10.30	126	.07	.06	.00	100.	1.01	23.00	276	.02	.02	.00	31.
1.01	10.35	127	.07	.06	.00	100.	1.01	23.05	277	.02	.02	.00	31.
1.01	10.40	128	.07	.06	.00	100.	1.01	23.10	278	.02	.02	.00	31.
1.01	10.45	129	.07	.06	.00	100.	1.01	23.15	279	.02	.02	.00	31.
1.01	10.50	130	.07	.06	.00	100.	1.01	23.20	280	.02	.02	.00	31.
1.01	10.55	131	.07	.06	.00	100.	1.01	23.25	281	.02	.02	.00	31.
1.01	11.00	132	.07	.06	.00	100.	1.01	23.30	282	.02	.02	.00	31.
1.01	11.05	133	.07	.06	.00	100.	1.01	23.35	283	.02	.02	.00	31.
1.01	11.10	134	.07	.06	.00	100.	1.01	23.40	284	.02	.02	.00	31.
1.01	11.15	135	.07	.06	.00	100.	1.01	23.45	285	.02	.02	.00	31.
1.01	11.20	136	.07	.06	.00	100.	1.01	23.50	286	.02	.02	.00	31.
1.01	11.25	137	.07	.06	.00	100.	1.01	23.55	287	.02	.02	.00	31.
1.01	11.30	138	.07	.05	.00	100.	1.02	0.00	288	.02	.02	.00	31.
1.01	11.35	139	.07	.06	.00	100.	1.02	.05	289	0.00	0.00	0.00	28.
1.01	11.40	140	.07	.06	.00	100.	1.02	.10	290	0.00	0.00	0.00	22.
1.01	11.45	141	.07	.06	.00	100.	1.02	.15	291	0.00	0.00	0.00	13.
1.01	11.50	142	.07	.06	.00	100.	1.02	.20	292	0.00	0.00	0.00	7.
1.01	11.55	143	.07	.05	.00	100.	1.02	.25	293	0.00	0.00	0.00	4.
1.01	12.00	144	.07	.06	.00	100.	1.02	.30	294	0.00	0.00	0.00	2.
1.01	12.05	145	.20	.19	.00	115.	1.02	.35	295	0.00	0.00	0.00	1.
1.01	12.10	146	.20	.19	.00	150.	1.02	.40	296	0.00	0.00	0.00	1.
1.01	12.15	147	.20	.20	.00	214.	1.02	.45	297	0.00	0.00	0.00	0.
1.01	12.20	148	.20	.20	.00	254.	1.02	.50	298	0.00	0.00	0.00	0.
1.01	12.25	149	.20	.20	.00	275.	1.02	.55	299	0.00	0.00	0.00	0.
1.01	12.30	150	.20	.20	.00	287.	1.02	1.00	300	0.00	0.00	0.00	0.

SUM 30.81 29.92 .89 46346.
(783.)(760.)(22.)(1312.37)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2115.	503.	161.	154.	46329.
CMS	60.	14.	5.	4.	1312.
INCHES		23.40	29.92	29.92	29.92
MM		594.40	760.09	760.09	760.09
AC-FT		249.	319.	319.	319.
THOUS CU M		308.	394.	394.	394.

HYDROGRAPH AT STA 10195 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	2.	2.	3.	3.
4.	4.	5.	5.	6.	6.	7.	7.	7.	8.
8.	8.	9.	9.	9.	10.	10.	10.	10.	11.
11.	11.	11.	11.	12.	12.	12.	12.	12.	13.
13.	13.	13.	13.	13.	14.	14.	14.	14.	14.
14.	14.	14.	15.	15.	15.	15.	15.	15.	15.
15.	15.	20.	34.	52.	69.	73.	78.	82.	84.
86.	87.	88.	89.	90.	91.	91.	92.	92.	93.
93.	94.	94.	94.	95.	95.	95.	95.	96.	96.
96.	97.	97.	97.	97.	97.	98.	98.	98.	98.

98.	98.	98.	98.	99.	99.	99.	99.	99.	99.
99.	99.	99.	99.	99.	100.	100.	100.	100.	100.
100.	100.	100.	100.	100.	100.	100.	100.	100.	100.
100.	100.	100.	100.	115.	150.	214.	254.	275.	287.
294.	298.	302.	302.	302.	303.	307.	321.	330.	350.
356.	340.	362.	363.	354.	355.	365.	365.	372.	392.
417.	435.	445.	450.	453.	455.	457.	457.	457.	457.
445.	424.	439.	497.	606.	826.	1354.	1967.	2113.	1318.
1402.	1086.	855.	686.	579.	511.	474.	453.	441.	431.
430.	429.	428.	425.	421.	401.	376.	359.	344.	303.
340.	333.	337.	337.	336.	336.	311.	246.	154.	103.
71.	53.	43.	37.	34.	32.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
31.	31.	31.	31.	31.	31.	31.	31.	28.	22.
13.	7.	4.	2.	1.	1.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2113.	503.	161.	154.	45324.
CMS	60.	14.	5.	4.	1312.
INCHES		21.42	29.92	29.92	29.92
MM		544.40	760.09	760.09	760.09
AC-FT		249.	319.	319.	319.
THOUS CU M		308.	394.	394.	394.

HYDROGRAPH AT STA 10393 FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	2.
2.	2.	2.	3.	3.	3.	3.	4.	4.	4.
4.	4.	4.	5.	5.	5.	5.	5.	5.	5.
5.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	8.	8.
8.	8.	19.	17.	26.	33.	37.	39.	41.	42.
43.	43.	44.	45.	45.	45.	46.	46.	46.	46.
47.	47.	47.	47.	47.	48.	48.	48.	48.	48.
48.	48.	48.	49.	49.	49.	49.	49.	49.	49.
49.	49.	49.	49.	49.	49.	49.	49.	49.	50.
50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
50.	50.	50.	50.	50.	50.	50.	50.	50.	50.
50.	50.	53.	50.	57.	90.	107.	127.	138.	144.
147.	149.	153.	151.	151.	151.	154.	161.	169.	175.
178.	180.	181.	182.	192.	182.	182.	183.	186.	196.
208.	217.	222.	225.	227.	228.	228.	228.	228.	229.
222.	212.	219.	248.	303.	414.	677.	984.	1057.	909.
701.	543.	423.	344.	283.	256.	237.	227.	220.	217.
215.	214.	214.	214.	211.	200.	188.	179.	174.	171.
170.	167.	169.	69.	168.	168.	157.	123.	42.	32.
36.	26.	21.	19.	17.	16.	16.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	16.	15.	15.	15.	16.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
15.	15.	15.	15.	15.	15.	15.	15.	14.	11.

```
       7.        4.        2.        1.        1.        0.        0.        0.        0.        0.

                         PEAK    6-HOUR    24-HOUR   72-HOUR   TOTAL VOLUME
                 CFS     1057.     252.       80.       77.       23162.
                 CMS       30.       7.        2.        2.         656.
              INCHES              11.70     14.96     14.96        14.96
                  MM             297.20    380.04    380.04       380.04
               AC-FT               125.      160.      160.         160.
          THOUS CU M               154.      197.      197.         197.


    **********        **********        **********        **********        **********

                                   HYDROGRAPH ROUTING

               ROUTE HYDROGRAPH THROUGH URSEL GINGERICH DAM

                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         10393       1       0       0       0       0       0       0       0
                                                ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       1       1       0       0               0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             0       0       0   0.000   0.000   0.000   -967.      -1

  STAGE      967.00      968.80      970.27      971.34      971.59      973.13      976.13      979.13

   FLOW        0.00       17.00      217.00      560.00     1012.00     4245.00    15538.00    30951.00

    CAPACITY=        0.       49.       96.      393.

   ELEVATION=      955.      967.      970.      980.

                          CREL   SPWID   COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                         967.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                            DAM DATA
                                  TOPEL    COQD    EXPD   DAMWID
                                  970.3     0.0     0.0       0.

                              STATION  103936 PLAN 1, RATIO 1

                              END-OF-PERIOD HYDROGRAPH ORDINATES

                                            OUTFLOW
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
            0.        0.        0.        0.        0.        1.        1.        1.        1.        1.
            1.        1.        1.        1.        1.        1.        1.        1.        1.        1.
            1.        1.        1.        1.        1.        1.        2.        2.        2.        2.
            2.        2.        2.        2.        2.        2.        2.        2.        2.        2.
            2.        2.        2.        3.        3.        3.        3.        4.        4.        4.
            5.        5.        5.        6.        6.        7.        7.        7.        8.        8.
            8.        9.        9.       10.       10.       10.       11.       11.       11.       12.
           12.       13.       13.       13.       14.       14.       14.       15.       15.       16.
```

SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 .50
				RATIOS APPLIED TO FLOWS	
HYDROGRAPH AT	10393	.20	1	2113.	1057.
	(	.52)	(	59.85)(	29.92)(
ROUTED TO	10393	.20	1	1680.	475.
	(	.52)	(	47.58)(	13.44)(
HYDROGRAPH AT	10851	1.01	1	7243.	3622.
	(	2.62)	(	205.10)(	102.55)(
2 COMBINED	10851	1.21	1	8718.	4095.
	(	3.13)	(	246.86)(	115.96)(
ROUTED TO	10851	1.21	1	7322.	2742.
	(	3.13)	(	207.34)(	77.63)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	967.00	967.00	970.30
STORAGE	48.	48.	96.
OUTFLOW	0.	0.	227.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	971.99	1.69	132.	1680.	5.33	15.83	0.00
.50	971.07	.77	113.	475.	2.17	16.08	0.00

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	904.00	904.00	906.59
STORAGE	151.	151.	325.
OUTFLOW	0.	0.	1653.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	911.13	2.63	482.	7322.	4.67	15.17	0.00
.50	909.46	.96	377.	2742.	1.75	16.33	0.00

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT          10393
ROUTE HYDROGRAPH TO           10393
RUNOFF HYDROGRAPH AT          10851
COMBINE 2 HYDROGRAPHS AT      10851
ROUTE HYDROGRAPH TO
END OF NETWORK
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**************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
**************************************

RUN  DATE* 79/10/09.
     TIME* 15.33.50.

                    DAM SAFETY INSPECTION - MISSOURI
                     LANCASTER CITY DAM (MO.10851)
                           PERCENT PMF

                          JOB SPECIFICATION
   NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
  300       0       5       0       0       0       0       0       4       0
                        JOPER     NWT   LROPT   TRACE
                            5       0       0       0

                    MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1 NRTIO= 5 LRTIO= 1
     RTIOS=    .35     .36     .37     .38     .39

**********          **********          **********          **********          **********

                         SUB-AREA RUNOFF COMPUTATION

   INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS

          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
          10393       0       0       0       0       0       0       0       0

                            HYDROGRAPH DATA
   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       1       2     .20    0.00     .20    1.00   0.000       0       0       0

                               PRECIP DATA
           SPFE     PMS      R6     R12     R24     R48     R72     R96
           0.00   23.70  100.00  120.00  130.00    0.00    0.00    0.00

                                LOSS DATA
   LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
       0    0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -93.00    0.00    0.00

   CURVE NO = -93.00  WETNESS =   -1.00  EFFECT CN =   93.00

                          UNIT HYDROGRAPH DATA
                       TC=  0.00      LAG=   .19

                             RECESSION DATA
            STRTQ=    0.00    QRCSN=    0.00     RTIOR= 1.00

                          END-OF-PERIOD FLOW
   MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q    MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q
```

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                                                                      SUM  30.41  29.92    .89   46346.
                                                                         ( 783.)( 760.)(  22.)( 1312.37)

          **********          **********          **********          **********          **********

                                         HYDROGRAPH ROUTING

                    ROUTE HYDROGRAPH THROUGH URSEL GINGERICH DAM

                            ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                            10333       1       0       0       0       0       0       0       0
                                                  ROUTING DATA
                    QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                      0.0   0.000    0.00       1       1       0       0               0

                            NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                                0       0       0   0.000   0.000   0.000   -967.      -1

  STAGE      967.00     968.80     970.27     971.34     971.69     973.13     976.13     979.13

   FLOW        0.00      17.00     217.00     560.00    1010.00    4240.00   15530.00   30951.00

    CAPACITY=       0.        48.        96.       303.

   ELEVATION=     955.       967.       970.       990.

                          CREL   SPWID   COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                         967.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                                    DAM DATA
                                         TOPEL    COQD    EXPD  DAMWID
                                         970.3     0.0     0.0      0.

 PEAK OUTFLOW IS      300. AT TIME  16.08 HOURS

 PEAK OUTFLOW IS      312. AT TIME  16.08 HOURS

 PEAK OUTFLOW IS      324. AT TIME  16.58 HOURS

 PEAK OUTFLOW IS      336. AT TIME  16.08 HOURS

 PEAK OUTFLOW IS      348. AT TIME  16.08 HOURS

          **********          **********          **********          **********          **********

                                  SUB-AREA RUNOFF COMPUTATION

                    INPUT PRECIPITATION VALUES, RATIOS AND UNIT HYDROGRAPH PARAMETERS

                            ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
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```
                        10851       0       0       0       0       0       0       0       0

                                          HYDROGRAPH DATA
        IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
            1       2    1.01    0.00    1.01    1.00   0.000       0       0       0

                                           PRECIP DATA
                 SPFE     PMS      R6     R12     R24     R48     R72     R96
                 0.00   23.70  100.00  120.00  133.00    0.00    0.00    0.00

                                            LOSS DATA
    LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
        0    0.00    0.00    1.00    0.00    0.00    1.00   -1.00  -93.00    0.00    0.00

          CURVE NO = -93.00   WETNESS =   -1.00   EFFECT CN =   93.00

                                       UNIT HYDROGRAPH DATA
                                       TC=  0.00    LAG=   .44

                                          RECESSION DATA
                               STRTQ=    0.00    QRCSN=    0.00    RTIOR= 1.00

                                       END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

                                                                  SUM  33.81  29.92    .89  233819.
                                                                      ( 783.)( 760.)(  22.)( 6622.72)


      **********       **********       **********       **********       **********

                                       COMBINE HYDROGRAPHS

             COMBINE HYDROGRAPHS BEFORE LANCASTER CITY LAKE ROUTING

                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         10851       2       0       0       0       0       0       0       0


      **********       **********       **********       **********       **********

                                       HYDROGRAPH ROUTING

            ROUTE COMBINED HYDROGRAPH THROUGH LANCASTER CITY DAM

                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                     1       0       0       0       0       0       0       0
                                                ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.000    0.00       1       1       0       0               0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             1       0       0   0.000   0.000   0.000    -904      -1

 STAGE     904.00    906.98    907.72    908.46    909.00    909.93    912.12    913.48    915.88

 FLOW        0.00    868.00   1238.00   1625.00   2000.00   3500.00  10496.00  17510.00  29664.00
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```
  CAPACITY=       0.      151.      325.      348.     1040.     3709.
 ELEVATION=     890.      904.      908.      909.      920.      940.

                        CREL     SPWID     COQW     EXPW     ELEVL     COQL     CAREA     EXPL
                       904.0       0.0      0.0      0.0       0.0      0.0       0.0      0.0

                                                    DAM DATA
                                            TOPEL     COQD     EXPD   DAMWID
                                            905.5      0.0      0.0       0.

PEAK OUTFLOW IS     1610. AT TIME  16.50 HOURS

PEAK OUTFLOW IS     1677. AT TIME  16.50 HOURS

PEAK OUTFLOW IS     1740. AT TIME  16.50 HOURS

PEAK OUTFLOW IS     1803. AT TIME  16.50 HOURS

PEAK OUTFLOW IS     1865. AT TIME  16.50 HOURS

          ***********      ***********      ***********      ***********      ***********
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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .35	RATIO 2 .36	RATIO 3 .37	RATIO 4 .38	RATIO 5 .39
				RATIOS APPLIED TO FLOWS				
HYDROGRAPH AT	10393	.20	1	740.	761.	782.	[illegible]	824.
	(	.52)	(	20.95)(	21.54)(	22.14)(	22.74)(	23.34)(
ROUTED TO	10393	.20	1	300.	312.	324.	336.	348.
	(	.52)	(	8.49)(	8.84)(	9.19)(	9.52)(	9.86)(
HYDROGRAPH AT	10851	1.01	1	2535.	2608.	2680.	2752.	2825.
	(	2.62)	(	71.79)(	73.84)(	75.89)(	77.94)(	79.99)(
2 COMBINED	10851	1.21	1	2831.	2916.	3001.	3085.	3170.
	(	3.13)	(	80.16)(	82.57)(	84.97)(	87.36)(	89.75)(
ROUTED TO		1.21	1	1610.	1677.	1740.	1803.	1865.
	(	3.13)	(	45.58)(	47.48)(	49.27)(	51.04)(	52.81)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	967.00	967.00	970.33
STORAGE	48.	48.	96.
OUTFLOW	0.	0.	227.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.35	970.53	.23	101.	300.	1.00	16.08	0.00
.36	970.57	.27	102.	312.	1.08	16.08	0.00
.37	970.60	.30	103.	324.	1.17	16.08	0.00
.38	970.64	.34	103.	336.	1.33	16.08	0.00
.39	970.68	.38	104.	348.	1.42	16.08	0.00

AD-A104 979 PRC CONSOER TOWNSEND INC ST LOUIS MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. LANCASTER CITY DAM (MO 10851), MIS--ETC(U)
DEC 79 W G SHIFRIN DACW43-79-C-0075

UNCLASSIFIED NL

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	904.00	904.00	908.50
STORAGE	181.	181.	325.
OUTFLOW	0.	0.	1653.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.35	908.43	0.00	322.	1510.	0.00	15.50	0.00
.36	908.53	.03	327.	1677.	.25	16.50	0.00
.37	908.62	.13	331.	1793.	.50	16.50	0.00
.38	908.72	.22	335.	1903.	.67	16.50	0.00
.39	908.81	.31	339.	1865.	.83	16.50	0.00

DATE

ILME